

Introduction



Blender 2.5 with a Big Buck Bunny scene open

Welcome to Blender! The Blender documentation consists of many parts: this user manual, a reference guide, tutorials, forums, and many other web resources. The first part of this manual will guide you through downloading Blender, installation, and if you select to download the sources, building an executable file to run on your machine.

Blender has a very unusual interface, highly optimized for 3D graphics production. This might be a bit confusing to a new user, but will prove its strength in the long run. It is highly recommended you read our section on [The Interface](#) carefully to get familiar with both the interface and with the conventions used in the documentation.

What is Blender?

Blender was first conceived in December 1993 and born as a usable product in August 1994 as an integrated application that enables the creation of a diverse range of 2D and 3D content. Blender provides a broad spectrum of modeling, texturing, lighting, animation and video post-processing functionality in one package. Through its open architecture, Blender provides cross-platform interoperability, extensibility, an incredibly small footprint, and a tightly integrated workflow. Blender is one of the most popular Open Source 3D graphics applications in the world.

Aimed at media professionals and artists world-wide, Blender can be used to create 3D visualizations, stills as well as broadcast and cinema quality videos, while the incorporation of a real-time 3D engine allows for the creation of 3D interactive content for stand-alone playback.

Originally developed by the company 'Not a Number' (NaN), Blender now is continued as 'Free Software', with the source code available under the GNU GPL license. The Blender Foundation in the Netherlands coordinates its ongoing development.

Between 2008 and 2010, Key parts of Blenders were re-written to improve its functions, workflow and interface. The result of this work produced the version of the software known as Blender 2.5 (currently in stable release).

Key Features:



Image being rendered and post-processed

- Fully integrated creation suite, offering a broad range of essential tools for the creation of 3D content, including modeling, uv-mapping, texturing, rigging, skinning, animation, particle and other simulation, scripting, rendering, compositing, post-production, and game creation;
- Cross platform, with an OpenGL GUI that is uniform on all platforms (customizable with python scripts), ready to use for all current versions of Windows (XP, Vista, 7), Linux, OS X, FreeBSD, Sun and numerous other operating systems;
- High quality 3D architecture enabling fast and efficient creation work-flow;
- More than 200,000 downloads of each release (users) worldwide;
- User community support by forums for questions, answers, and critique at <http://BlenderArtists.org> and news services at <http://BlenderNation.com>;
- Small executable size, easy distribution;

You can download the latest version of Blender [here](#).

Blender's History

In 1988 Ton Roosendaal co-founded the Dutch animation studio *NeoGeo*. NeoGeo quickly became the largest 3D animation studio in the Netherlands and one of the leading animation houses in Europe. NeoGeo created award-winning productions (European Corporate Video Awards 1993 and 1995) for large corporate clients such as multi-national electronics company Philips. Within NeoGeo Ton was responsible for both art direction and internal software development. After careful deliberation Ton decided that the current in-house 3D tool set for NeoGeo was too old and cumbersome to maintain and upgrade and needed to be rewritten from scratch. In 1995 this rewrite began and was destined to become the 3D software creation suite we all now know as *Blender*. As NeoGeo continued to refine and improve Blender it became apparent to Ton that Blender could be used as a tool for other artists outside of NeoGeo.

In 1998, Ton decided to found a new company called Not a Number (NaN) as a spin-off of NeoGeo to further market and develop Blender. At the core of NaN was a desire to create and distribute a compact, cross platform 3D creation suite for free. At the time this was a revolutionary concept as most commercial modelers cost several thousands of (US) dollars. NaN hoped to bring professional level 3D modeling and animation tools within the reach of the general computing public. NaN's business model involved providing commercial products and services around Blender. In 1999 NaN attended its first Siggraph conference in an effort to more widely promote Blender. Blender's first Siggraph convention was a huge success and gathered a tremendous amount of interest from both the press and attendees. Blender was a hit and its huge potential confirmed!

On the wings of a successful Siggraph in early 2000, NaN secured financing of €4.5m from venture capitalists. This large inflow of cash enabled NaN to rapidly expand its operations. Soon NaN boasted as many as fifty employees working around the world trying to improve and promote Blender. In the summer of 2000, Blender v2.0 was released. This version of Blender added the integration of a game engine to the 3D suite. By the end of 2000, the number of users registered on the NaN website surpassed 250,000.

Unfortunately, NaN's ambitions and opportunities didn't match the company's capabilities and the market realities of the time. This over-extension resulted in restarting NaN with new investor funding and a smaller company in April 2001. Six months later NaN's first commercial software product, *Blender Publisher* was launched. This product was targeted at the emerging market of interactive web-based 3D media. Due to disappointing sales and the ongoing difficult economic climate, the new investors decided to shut down all NaN operations. The shutdown also included discontinuing the development of Blender. Although there were clearly shortcomings in the then current version of Blender, such as a complex internal software architecture, unfinished features and a non-standard way of providing the GUI, the enthusiastic support from the user community and customers who had purchased Blender Publisher in the past meant that Ton couldn't justify leaving Blender to disappear into oblivion. Since restarting a company with a sufficiently large team of developers wasn't feasible, Ton Roosendaal founded the non-profit organization *Blender Foundation* in March 2002.

The Blender Foundation's primary goal was to find a way to continue developing and promoting Blender as a community-based [Open Source](#) project. In July 2002, Ton managed to get the NaN investors to agree to a unique Blender Foundation plan to attempt to release Blender as open source. The "Free Blender" campaign sought to raise €100,000 so that the Foundation could buy the rights to the Blender source code and intellectual property rights from the NaN investors and subsequently release Blender to the open source community. With an enthusiastic group of volunteers, among them several ex-NaN employees, a fund raising campaign was launched to "Free Blender". To everyone's surprise and delight the campaign reached the €100,000 goal in only seven short weeks. On Sunday October 13, 2002, Blender was released to the world under the terms of the [GNU General Public License \(GPL\)](#). Blender development continues to this day driven by a team of far-flung, dedicated volunteers from around the world led by Blender's original creator, Ton Roosendaal.

Video: From Blender 1.60 to 2.50

Version/Revision Milestones



Release Notes

To see release notes for each version, you can click on the version number.

- From 1.00 to 2.30, there are no more links for release notes;
- From 2.30 to 2.40, you can find release notes only at [Blender Release Notes](#);
- From version 2.40 and up, the release notes are located at the Developers space in our wiki and at the [Blender Release Notes](#)

Blender's history and road-map:

The start !

- 1.00 – January 1995: Blender in development at animation studio NeoGeo.
- 1.23 – January 1998: SGI version published on the web, IrisGL.
- 1.30 – April 1998: Linux and FreeBSD version, port to OpenGL and X.
- 1.3x – June 1998: NaN founded.
- 1.4x – September 1998: Sun and Linux Alpha version released.
- 1.50 – November 1998: First Manual published.
- 1.60 – April 1999: C-key (new features behind a lock, \$95), Windows version released.
- 1.6x – June 1999: BeOS and PPC version released.
- 1.80 – June 2000: End of C-key, Blender full freeware again.

Blender 2.0

- 2.00 – August 2000: Interactive 3D and real-time engine.
- 2.10 – December 2000: New engine, physics, and Python.
- 2.20 – August 2001: Character animation system.
- 2.21 – October 2001: Blender Publisher launch.
- 2.2x – December 2001: Mac OSX version.

Blender goes Open Source

- **13 October 2002: Blender goes Open Source, 1st Blender Conference.**
- 2.25 – October 2002: [Blender Publisher](#) becomes freely available.
- Tuhopuu1 – Oct 2002: The experimental tree of Blender is created, a coder's playground.
- 2.26 – February 2003: The first true Open Source Blender.
- 2.27 – May 2003: The second Open Source Blender.
- 2.28x – July 2003: First of the 2.28x series.
- [2.30](#) – October 2003: [Preview release](#) of the 2.3x UI makeover presented at the 2nd Blender Conference.
- [2.31](#) – December 2003: [Upgrade](#) to stable 2.3x UI project.
- [2.32](#) – January 2004: [Major overhaul](#) of internal rendering capabilities.
- [2.33](#) – April 2004: [Game Engine returns](#), ambient occlusion, new procedural textures.
- [2.34](#) – August 2004: [Big improvements](#): particle interactions, LSCM UV mapping, functional YafRay integration, weighted creases in subdivision surfaces, ramp shaders, full OSA, and many many more.
- [2.35](#) – November 2004: [Another version full of improvements](#): object hooks, curve deforms and curve tapers, particle duplicators and much more.
- [2.36](#) – December 2004: [A stabilization version](#), much work behind the scene, normal and displacement mapping improvements.

A Big Leap

- [2.37](#) – June 2005: [A big leap](#): transformation tools and widgets, softbodies, force fields, deflections, incremental subdivision surfaces, transparent shadows, and multithreaded rendering.
- [2.40](#) – December 2005: [An even bigger leap](#): full rework of armature system, shape keys, fur with particles, fluids and rigid bodies.
- [2.41](#) – January 2006: [Lots of fixes](#), and some game engine features.
- [2.42](#) – July 2006: [The Node release](#). Over [50 developers](#) contributed nodes, array modifier, vector blur, new physics engine, rendering, lipsync and, many other features. This was the release following [Project Orange](#).
- [2.43](#) – February 2007: [The Multi release](#): multi-resolution meshes, multi-layer UV textures, multi-layer images and multi-pass rendering and baking, sculpting, retopology, multiple additional matte, distort and filter nodes, modeling and animation improvements, better painting with multiple brushes, fluid particles, proxy objects, sequencer rewrite, and post-production UV texturing. whew! Oh, and a website rewrite. And yes, it still has multi-threaded rendering for multi-core CPUs. With Verse it is multi-user, allowing multiple artists to work on the same scene collaboratively. Lastly, render farms still provide multi-workstation distributed rendering.
- [2.44](#) – May 2007: [The SSS release](#): the big news, in addition to two new modifiers and re-awakening the 64-bit OS support, was the addition of subsurface scattering, which simulates light scattering beneath the surface of organic and soft objects.

- [2.45](#) – September 2007: [Another bugfix release](#): serious bugfixes, with some performance issues addressed.
- [2.46](#) – May 2008: [The Peach release](#) was the result of a huge effort of over 70 developers providing enhancements to the core and patches to provide hair and fur, a new particle system, enhanced image browsing, cloth, a seamless and non-intrusive physics cache, rendering improvements in reflections, AO, and render baking; a mesh deform modifier for muscles and such, better animation support via armature tools and drawing, skinning, constraints and a colorful Action Editor, and much more. It was the release following [Project Peach](#).
- [2.47](#) – August 2008: [Bugfix release](#).
- [2.48](#) – October 2008: [The Apricot release](#): cool GLSL shaders, lights and GE improvements, snap, sky simulator, shrinkwrap modifier, python editing improvements.
- [2.49](#) – June 2009: [The Pre-Re-Factor release](#) added significant enhancements to the core and GE. Core enhancements include node-based textures, armature sketching (called Etch-a-Ton), boolean mesh operation improvements, JPEG2000 support, projection painting for direct transfer of images to models, and a significant Python script catalog. GE enhancements included video textures, where you can play movies in-game (!), upgrades to the Bullet physics engine, dome (fish-eye) rendering, and more API GE calls made available.

Blender 2.5 - The Recode !

- [2.5x](#) – From 2009 to August 2011. This series [release](#) 4 pre-version (from Alpha0 - November 2009 - to Beta July 2010) and three stable versions (from 2.57 - April 2011 - to 2.59 - August 2011). It is one of the most important development [project](#) of blender with a total re-coding of the software with new functions, redesign of internal window manager and event/tool/data handling system, new python API... The final version of this project was Blender 2.59 in August 2011.
- [2.60](#) – October 2011: [Internationalization of the UI, 3D Audio and Video](#). This release incorporates improvements in Animation System and Game Engine, Vertex Weight Groups Modifiers, 3D Audio and Video, Bug Fixes, and the UI Internationalization (Garlic Branch merged into trunk).
- [2.61](#) – December 2011: [Camera Track, Ocean Simulation, Cycles Render Engine, Dynamic Paint](#). The new Cycles Render Engine is now added in the Blender default installation, also Camera Tracking for mixing footages with 3D, Dinamyc Paint for modifying Textures with Mesh contact/aproximation, the Ocean Simulation is a new Modifier to simulate Ocean and Foam (Ported from the open source Houdini Ocean Toolkit), New Addons, Bug Fixes, and more extensions added for the Python API.
- [2.62](#) - February 2012: [Carve Booleans, Motion Tracking, Remesh Modifier](#). The [Carve](#) library is now added to improve results when performing Boolean operations, Blender now support Motion Tracking for object movements in the Scene, the Remesh Modifier generate new topology using an input Mesh as a base, many improvements in Game Engine, Collada, Bump Mapping, Dynamic Paint, UV Tools, Cycles Render Engine, Matrices and Vectors in Pyhton API were improved, New Addons, and many bugs were fixed.

Bmesh - Blender with N-gons !

- [2.63](#) - April 2012: [A new mesh system has been added to Blender, with full support for N-sided Poligons instead of only triangles and quads](#), Sculpt Hiding, Cycles Render with panoramic Camera, mirror ball environment textures and float precision textures, render layer mask layers, ambient occlusion and viewport display of background images and render layers, Motion Tracker with few smaller improvements, new Import and Export Addons were added, and Renderfarm.fi now supports Cycles. 150 bugfixes for bugs that existed in previous releases.

About Free Software and the GPL



When one hears about "free software", the first thing that comes to mind might be "no cost". While this is true in most cases, the term "free software" as used by the Free Software Foundation (originators of the GNU Project and creators of the GNU General Public License) is intended to mean "free as in freedom" rather than the "no cost" sense (which is usually referred to as "free as in free beer"). Free software in this sense is software which you are free to use, copy, modify, redistribute, with no limit. Contrast this with the licensing of most commercial software packages, where you are allowed to load the software on a single computer, are allowed to make no copies, and never see the source code. Free software allows incredible freedom to the end user. Since the source code is universally available, there are also many more chances for bugs to be caught and fixed.

When a program is licensed under the GNU General Public License (the GPL):

- you have the right to use the program for any purpose
- you have the right to modify the program, and have access to the source codes
- you have the right to copy and distribute the program
- you have the right to improve the program, and release your own versions.

In return for these rights, you have some responsibilities if you distribute a GPL'd program, responsibilities that are designed to protect your freedoms and the freedoms of others:

- You must provide a copy of the GPL with the program, so that the recipient is aware of his rights under the license.
- You must include the source code or make the source code freely available.
- If you modify the code and distribute the modified version, you must license your modifications under the GPL and make the source code of your changes available. (You may not use GPL'd code as part of a proprietary program.)
- You may not restrict the licensing of the program beyond the terms of the GPL. (You may not turn a GPL'd program into a proprietary product.)

For more on the GPL, check the [GNU Project Web site](#).

Note: The GPL only applies to the blender application and **not** the artwork you create with it, for more info see: [The GPL For Artists](#)

Getting support: the Blender community

Being freely available from the start, even while closed source, helped considerably in Blender's adoption. A large, stable and active community of users has gathered around Blender since 1998. The community showed its support for Blender in 2002 when they helped raise €100,000 in seven weeks to enable Blender to go Open Source under the [GNU GPL](#).

The community spans two widely overlapping sites:



The Development Community, centered around the [Blender Foundation site](#). Here you will find the home of the development projects, the Functionality and Documentation Boards, the CVS repository with Blender sources, all documentation sources, and related public discussion forums. Developers contributing code to Blender itself, Python scripters, documentation writers, and anyone working for Blender development in general can be found here.

Go to <http://www.blender.org>



The User Community, centered around the independent [BlenderArtists](#) site. Here Blender artists, gamemakers and fans gather to show their creations, get feedback, ask for and offer help to get a better insight into Blender's functionality. Blender Tutorials and the Knowledge Base can be found here as well.

Go to <http://www.BlenderArtists.org>

These two websites are not the only Blender resources. The worldwide community has created a large number of independent sites, in local languages or devoted to specialized topics. A constantly updated list of Blender resources can be found at the above mentioned sites.

IRC chat channels

For immediate online feedback there are three IRC chat channels permanently open on [irc.freenode.net](#). You can join these with your favorite IRC client:

- [#blender](#) Community support channel
- [#blenderchat](#) for general discussion of blender
- [#blenderqa](#) for asking questions on Blender usage
- [#gameblender](#) for discussion on issues related to game creation with Blenders included game engine

For developers there is also :

- [#blendercoders](#) for developers to ask questions and discuss development issues, as well as a meeting each Sunday at 4 pm Netherlands time
- [#blenderpython](#) for discussion of the python API and script development
- [#blenderwiki](#) for questions related to editing the wiki

Who uses Blender?

The Blender community is made up of people from all over the world, with novice and professional graphic artists, occasional users and commercial houses. This manual is written to serve the wide array of Blender users. You might be interested in using Blender if you are a:

- Hobbyist/Student that wants to explore the world of computer graphics (CG) and 3D animation
- 2-D artist that produces single image art/posters or enhances single images as part of an image post-processing lab
- 2-D artist or team that produces cartoon/caricature animations for television commercials or shorts (such as "The Magic of Amelia")
- 3-D artist that works alone or with another person to produce short CG animations, possibly featuring some live action (such as "Suburban Plight").
- 3-D team that produces an animated (100% CG) movie (such as "[Elephant's Dream](#)", "[Plumiferos](#)", "[Big Buck Bunny](#)" or "[Sintel](#)").
- 3-D team that works together to produce live action movies that include some CG.

2D and 3D teams that produce movies and animations often specialise in certain aspects of CG. Some of these specific jobs that could use Blender include:

- Director - Defines what each Scene should contain, the action (animation) and shots (camera takes) within that scene.
- Modeler - Makes assets for the production. Specialties include Character, Prop and Landscapes/Stage modelers.
- Cameraman, Director of Photography (DP) - sets up the camera and its motion, shoots the live action, renders the output

frames.

- Material Painter - paints the set, the actors, and anything that moves.
- Animation and Rigging - makes things hop about using armatures.
- Lighting and Color Specialist - Lights the stage and sets, adjusts colors to look good in the light, adds dust and dirt to materials, scenes, and textures.
- Special Purpose talent - Fluids, motion capture, cloth, dust, dirt, fire and explosion.
- Editor - takes all the raw footage from the DP and sequences it into an enjoyable movie.

About this manual

This manual is a mediawiki implementation that is written by a world-wide collaboration of volunteer [authors](#). It is updated daily, and this is the English version. Other language versions are translated, generally, from this English source for the convenience of our world-wide audience. It is constantly out of date, thanks to the tireless work of some 50 or more volunteer developers, working from around the world on this code base. However, it is the constructive goal to provide you with the best possible professional documentation on this incredible package.

To assist you in the best and most efficient way possible, this manual is organized according to the creative process generally followed by 3D artists, with appropriate stops along the way to let you know how to navigate your way in this strange territory with a new and deceptively complex software package. If you read the manual linearly, you will follow the path most artists use in both learning Blender *and* developing fully animated productions:

1. Getting to know Blender = Intro, Navigating in 3d, scene mgt
2. Models = Modeling, Modifiers
3. Lighting
4. Shading = Materials, Textures, Painting, Worlds & Backgrounds
5. Animation = Basics, Characters, Advanced, Effects & Physical Sim
6. Rendering = Rendering, Compositing, Video Seq Edit
7. Beyond Blender = Extending Blender

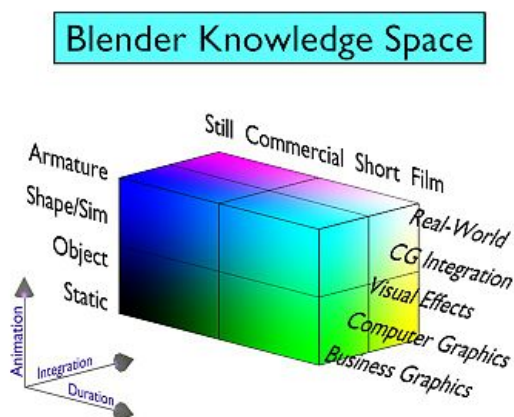
Audience

This manual is written for a very broad audience, to answer the question "I want to *do something*; how do I do it using Blender?" all the way to "what is the latest change in the way to sculpt a mesh?"

This manual is a worldwide collaborative effort using time donated to the cause. While there may be some lag between key features being implemented and their documentation, we do strive to keep it as up-to-date as possible. We try to keep it narrowly focused on what you, the end user, need to know, and not digress too far off topic, as in discussing the meaning of life.

There are [other Blender wiki books](#) that delve deeper into other topics and present Blender from different viewpoints, such as the Tutorials, the Reference Manual, the software itself, and its scripting language. So, if a question is not answered for you in this User Manual, please search the other [Blender wiki books](#).

Learning CG and Blender



Getting to know Blender and learning Computer Graphics (CG) are two different topics. Learning what a computer model is, and then learning how to develop one in Blender are two different things to learn. Learning good lighting techniques, and then learning about the different kinds of lamps in Blender are two different topics. The first, or conceptual understanding, is learned by taking secondary and college courses in art and media, by reading books available from the library or bookstore on art and computer graphics, and by trial and error. Even though a book or article may use a different package (like Max or Maya) as its tool, it may still be valuable because it conveys the concept.

Once you have the conceptual knowledge, you can easily learn Blender (or any other CG package). Learning both at the same time is difficult, since you are dealing with two issues. The reason for writing this is to make you aware of this dilemma, and how this manual attempts to address both topics in one wiki book. The conceptual knowledge is usually addressed in a short paragraph or two at the beginning of a topic or chapter, that explains the topic and provides a workflow, or process, for accomplishing the task. The rest of the manual section addresses the specific capabilities and features of Blender. The user manual cannot give you the full conceptual knowledge - that comes from reading books, magazines, tutorials and sometimes a lifetime of effort. You can use Blender to produce a full-length feature film, but reading this manual and using Blender won't make you another Steven Spielberg!

At a very high level, using Blender can be thought of as knowing how to accomplish imagery within three dimensions of activity:

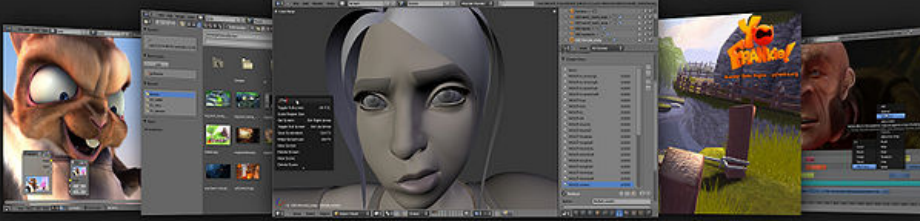
1. Integration - rendering computer graphics, working with real-world video, or mixing the two (CGI and VFX)
2. Animation - posing and making things change shape, either manually or using simulation
3. Duration - producing a still image, a short video, a minute-long commercial, a ten minute indie short, or a full-length feature film.

Skills, like navigating in 3D space, modeling, lighting, shading, compositing, and so forth are needed to be productive in any given area within the space. Proficiency in a skill makes you productive. Tools within Blender have applicability within the space as well. For example, the video sequence editor (VSE) has very little to do with the skill of animation, but is deeply applicable along the Duration and Integration scales. From a skills-learning integration perspective, it is interesting to note that the animation curve, called an lpo curve, is used in the VSE to animate effects strips.

At the corners/intersections is where most people's interest's lie at any given time; a sort of destination, if you will. For example, there are many talented artists that produce Static-Still-CG images. Tony Mullen's book *Introducing Character Animation With Blender* addresses using CG models deformed by Armatures and shapes to produce a one-minute animation. Using Blender fluids in a TV production/commercial is at the Shape/Sim-Integrated-Minute intersection. Elephants Dream and Big Buck Bunny is a bubble at the Armature-CG-Indie space. Therefore, depending on what you want to do, various tools and topics within Blender will be of more or less interest to you.

A fourth dimension is Game Design, because it takes all of this knowledge and wraps Gaming around it as well. A game not only has a one-minute cinematic in it, but it also has actual game play, story line programming, etc. -- which may explain why it is so hard to make a game; you have to understand all this stuff before you actually can construct a game. Therefore, this Manual does not address using the Game Engine; that is a whole 'nother wiki book.

Blender 2.5



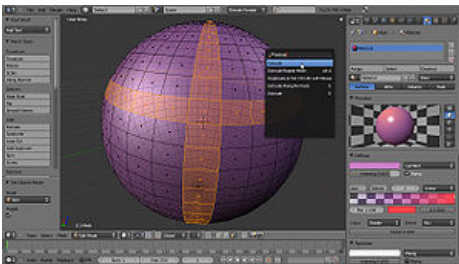
Introduction

With version 2.5, Blender has seen phenomenal improvements in virtually all areas: software, interface, modeling, animation flow, tools, the python API, etc. This is the result of a careful study of use cases, years of additions and community collaboration, and a complete reorganization and rewrite of the software source code. As a result, this is one of the largest projects undertaken on the Blender code base to date.

This page explains the most striking differences between Blender 2.4 and Blender 2.5. This is not an exhaustive list of new functionality (that would be too long!) but is rather a concise introduction to the evolution of 2.5 and its major improvements over previous versions.

Interface

New User Interface



The Blender User Interface is based on 3 principles:

1. **Non Overlapping** : The UI permits you to view all relevant options and tools at a glance without pushing or dragging windows around.
2. **Non Blocking** : Tools and interface options do not block the user from any other parts of Blender. Blender doesn't pop up requesters that require the user to fill in data before things execute.
3. **Non Modal** : User input should remain as consistent and predictable as possible without changing commonly used methods (mouse, keyboard) on the fly.

The User Interface has been reorganized. Old *Buttons Windows* are now **Properties**. Properties present data to users. Everything you see in the Properties can be animated, driven, and freely changed by the user. This means there are no tools here. These go to the new **Toolbar** of the different editors (like 3D view).



Starting at the top level, the Properties editor contains a list of tabs. The list of tabs themselves are organized so that the most general controls appear on the left (Render Properties), while more fine-grained controls (Object>Mesh>Material>Texture) appear on the right, following reading direction. Furthermore, available tabs depend on the selection (i.e. Mesh options are different from Camera options).

[Read more about new UI design rules »](#)

[Read more about 2.5 UI Paradigms »](#)

[Read more about new properties panel »](#)

Multi-screen

With its new Window Manager, Blender allows configuration of multiple windows/screens which is useful for multi-screen setups. As with the main window, each new window can be subdivided into areas.

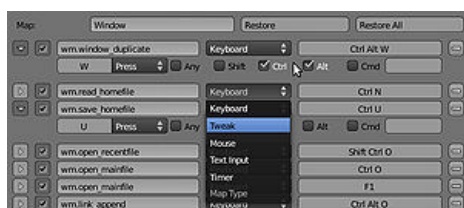
Customizable

```
33
34 class BONE_PT_context_bone(BoneButtonsPanel):
35     bl_label = ""
36     bl_show_header = False
37
38     def draw(self, context):
39         layout = self.layout
40
41         bone = context.bone
42         if not bone:
43             bone = context.edit_bone
44
45         row = layout.row()
46         row.itemL(text="", icon='ICON_BONE_DATA')
47         row.itemR(bone, "name", text="")
48
```

The UI is more flexible than it was in 2.4x. Thanks to the new python API, it is possible to customize the interface and change the place of panels or buttons. Most of the interface uses python scripts available in the `./blender/scripts/ui/` folder so you can edit them easily and make your own Blender interface.

Thanks to this new python API, it is easier for the developer to integrate scripts in the Blender interface (like render engine, tools, import/export scripts...).

[Read more about new python API »](#)



Furthermore, Blender 2.5 includes a new **Keymap Editor**. Hotkey/mouse definitions are grouped together in 'key maps'. For each editor in Blender as well as for all modes or modal tools like transform, there are multiple key maps. Customizing the keys is done by making a local copy of the default map and then editing all the options you'd like to have. The default key maps will always be unaltered and available to use.

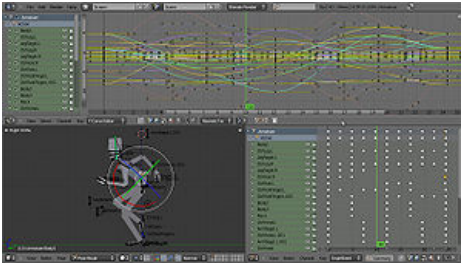
Animation system

Everything is animatable !

In Blender 2.5 every property can be animated from the output image size to the modifiers options. Now you can set keys on every editor : 3D view, video sequence editor, Node editor (material, texture, composite)... This new system is called *Animato*.

[Read more about Animato »](#)

Dope sheet and graph editor



The IPO Curves Editor, Action Editor, and NLA Editor have been rebuilt into the **Dope Sheet** and **Graph Editor** (generic name used also in Maya).

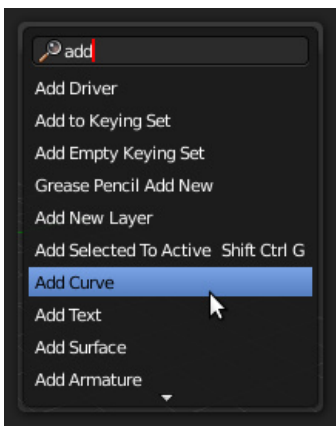
The "Action Editor" has been extended to become a full Dope Sheet, allowing control over multiple actions at once, grouping per type, and better access to shape keys.

Blender's new animation system also allows the addition of a Function Curve to any property. The new Graph Editor (formerly Ipo Curve Editor) enables viewing, browsing and editing of any collection of function curves, including all the curves of an entire scene!

[Watch this character animation »](#)

New functions

Search tool

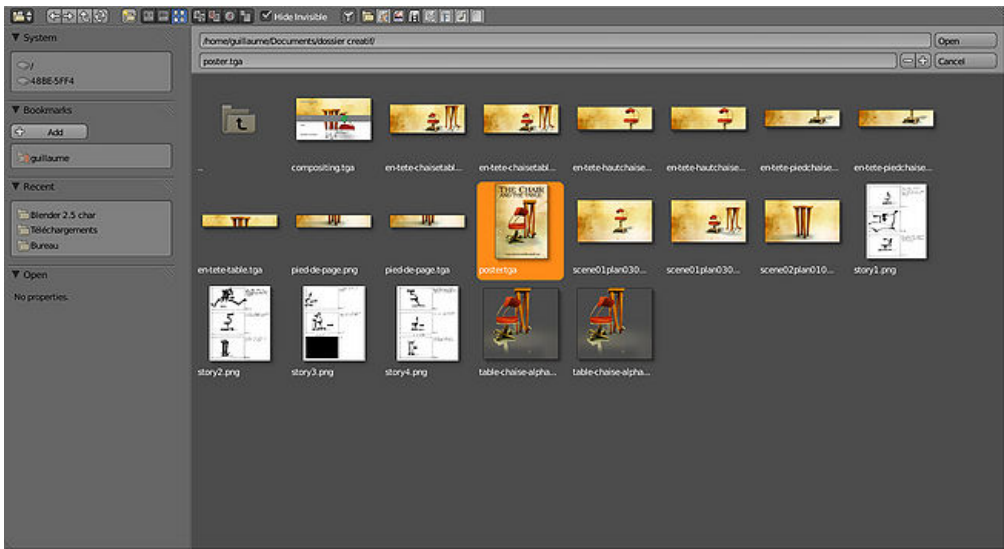


Blender 2.5 integrates a search tool which permits you to find a function by entering its name (or a part of it). Just hit Space where you want to search and the menu will appear. It is also available at the top of the Blender screen.

File browser improvements

The old file browser and Image browser have been linked into a single powerful browser. Files can be displayed as lists or thumbnails, and a new filter permits selection of which file types you want to show in the browser.

A side bar has also been added where you can see your disks, the most recent folder used, and a new function lets you create bookmarks !



Python API

Now based on Python 3.2

Watch this page on video !

This page has been made on video. You can watch it on YouTube!

Installing the Binaries

Blender 2.64 is available both as a binary executable and as source code on the Foundation site (<http://www.blender.org/>). Currently, to download Blender 2.64, select "Download Blender" from the right hand navigation menu on the [homepage](#).

For the online manual hosted at the wiki, you can generally use the most recent version of Blender located at the Blender Foundation website (although all of the features from the newest release version may not be fully updated). If you are using a published version of this manual it is recommended that you use the Blender version included on the Guide CD-ROM. In the following text, whenever "download" is mentioned, those using the book should instead retrieve Blender from the CD-ROM.

Downloading and installing the binary distribution

Binary distributions are provided for the following operating system families:

- [Windows](#)
- [Linux](#)
- [MacOSX](#)
- [FreeBSD](#)

Some unofficial distributions may exist for other operating systems, but as they're not supported by the [Blender Foundation](#), you should report any issues you may have with them directly to their maintainers.

Binaries for the Macintosh operating systems are provided for two different hardware architectures (x86 for Intel and AMD processors, and PowerPC), and for the choice between statically linked or dynamically loaded libraries.

The installer will create files and several folders in two locations on your computer: one set of folders is for the Blender program, and the other is a set of folders for your user data. You must have administrator authorization to create these. The folders are:

- .blender - configuration information (mostly prompts in your native language)
- blendcache_.B - temporary space for physics simulation information (softbodies, cloth, fluids)
- scripts - python scripts that extend Blender functionality
- tmp - temporary output, intermediate renders

Hardware Support

Blender supports 64-bit hardware platforms, removing the 2GB addressable memory limit.

Blender also supports multi-CPU/core chips such as the Intel Core-Duo and AMD X2 chips. A Threads setting is provided in the performance section of the render options to indicate how many cores to use in parallel when rendering. The Auto-detect setting will utilize all the cores available on your system, while the Fixed setting allows the user to manually specify the number of cores to be used when rendering.

Blender supports a wide variety of pen-based tablets on all major operating systems, in particular OS X, Windows XP, and Linux OSes.

Information on how to make render times shorter can be found in the [Render](#) section of the manual.

Developers platforms

This is the list of systems in use and supported by active Blender developers:

Name	OS	CPU	Graphics card
Andrea Weikert	Windows XP 32	AMD Athlon 64 X2	Nvidia Quadro FX1500
Andrea Weikert	Windows XP 32	Intel P4	ATI Radeon 9000
Benoit Bolsee	Windows XP 32	AMD Athlon XP	ATI Radeon 9200
Brecht van Lommel	Windows 7 64	Intel Core 2 Duo	NVidia GeForce 460 GTX
Daniel Genrich	Windows Vista 64	Intel Core 2 Duo	NVidia GeForce 8500 GT
Joshua Leung	Windows Vista 32	Intel Core2 Duo	Nvidia GeForce Go 7600
Nathan Letwory	Windows 7 Ultimate 64	AMD Turion X2 Mobile RM-74	ATI HD 4650
Nathan Letwory	Windows 7 Ultimate	AMD Athlon II X4 620	2x HIS ATI HD 5550 (w/ four monitors)

Contributor	OS	CPU	GPU
Robin Allen	Windows XP 32	Intel Centrino duo	NVidia GeForce go 7600
Thomas Dinges	Windows 7 x64	Intel Core 2 Quad	NVidia GeForce 8600 GT
Thomas Dinges	Windows 7 x64	Intel Core i7	NVidia GeForce 540M
Andrea Weikert	Linux 32	AMD Athlon 64 X2	Nvidia Quadro FX1500
Brecht van Lommel	Linux 64	Intel Core 2 Duo	NVidia GeForce 460 GTX
Campbell Barton	Linux 64	AMD Phenom II X6	Nvidia GeForce 6800 XT
Diego Borghetti	Linux 32	Intel Core 2 Duo	Nvidia 8400 GT
Diego Borghetti	Linux 64	AMD Athlon 64 X2	Nvidia 8600 GT
Ken Hughes	Linux 32	Intel Core Duo	Nvidia GeForce GO 7500
Ken Hughes	Linux 64	AMD Athlon 64 X2	Nvidia GeForce 6600
Kent Mein	Linux 64	Intel Core Duo	Nvidia Quadro FX 1400
Michael Fox	Linux 32	Celeron	Nvidia GeForce 6200
Raul Fernandez Hernandez	Linux 32	Pentium D 945	ATI X1550
Robin Allen	Linux 32	Intel Centrino duo	NVidia GeForce go 7600
Brecht van Lommel	OS X 10.6	Intel Core 2 Duo	NVidia GeForce 9600M GT
Dustin Martin	OSX 10.5	Dual Quad Intel	Nvidia Geforce 8800 GT
Jean-Luc Peurière	OSX 10.4	PPC dual G5	ATI 9650
Ton Roosendaal	OSX 10.5	PPC dual G5	ATI 9600
Ton Roosendaal	OSX 10.4	Dual Core Intel	ATI x1600
Matt Ebb	OSX 10.5	Dual Core Intel MBP	nVidia 8600M
Kent Mein	SunOS 5.8	Sun Blade 150	ATI PGX
Stefan Gartner	SGI Irix 6.5 (gcc)	R12000	V8
Timothy Baldrige	SGI Irix 6.5 (mipspro)	8 x R16000	(headless)
Timothy Baldrige	SGI Irix 6.5 (mipspro)	2 x R10000	
Marcel	Windows 7 64bit	AMD Athlon 4850e	ATI Radeon HD3200 IGP
Jeroen Bakker	Latest Ubuntu 64bit	Dell m4300 Intel Core 2 Duo 2.0Ghz	Nvidia Quadro FX360M
Sergey Sharybin	Debian Wheezy 64bit	Intel Core i7 920 2.6Ghz	Nvidia GeForce GTS 250
Sergey Sharybin	Debian Wheezy 64bit	Intel Core 2 Duo 1.8GHz	Mobile Intel 965 Express Chipset Family
Jens Verwiebe	OSX 10.6/7	Intel Xeon 6-core@ 3.33	ATI 5870

Compiling the Source

There are presently four build systems for making a binary for the different supported operating systems. Consult the [Building Blender](#) web page for more information about compiling a custom installation binary for your machine.

Python, a Scripting Language

[Python](#) is a general purpose scripting language that can be used to extend the functionality of Blender with regular installations available from the [Blender download](#) page. Blender comes bundled with the appropriate Python libraries so for regular usage a full install of Python is not required to run Python scripts.

Users wanting to [write their own scripts](#), [compile their own versions of Blender](#) or utilize some less common features may still need a full Python install. Users that want full Python functionality should refer to the [Python](#) website for installation instructions.

Installing on Windows

Download

You can obtain the latest stable version of Blender for Windows from the [Blender download page](#).

Version

Blender for Windows is currently available in 32-bit and 64-bit versions. Users with a 32-bit version of Windows must download the 32-bit version of Blender. Users with a 64-bit version of Windows can choose to use either the 32-bit or 64-bit version of Blender, however you will likely notice an increase in performance when using the 64-bit version of Blender, especially on systems with large amounts of RAM.

To determine whether you have a 32-bit or 64-bit version of Windows, you can look at the C:\ partition. If there is a *Program Files* (x64) folder then you have a 64-bit version of Windows. The *Program Files (x86)* folder is where 32-bit programs are stored.

Installation

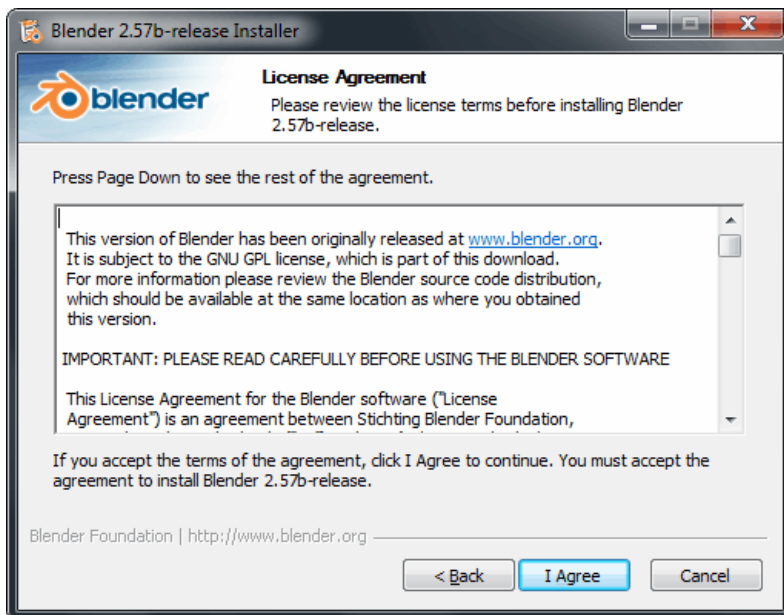
Once your download has finished, navigate to the *Downloads* folder and double-click the Blender executable file to start the installation process. Keep in mind that installing Blender requires Administrator rights.

Welcome screen



The Welcome is the first screen of the installation process. Click Next to continue.

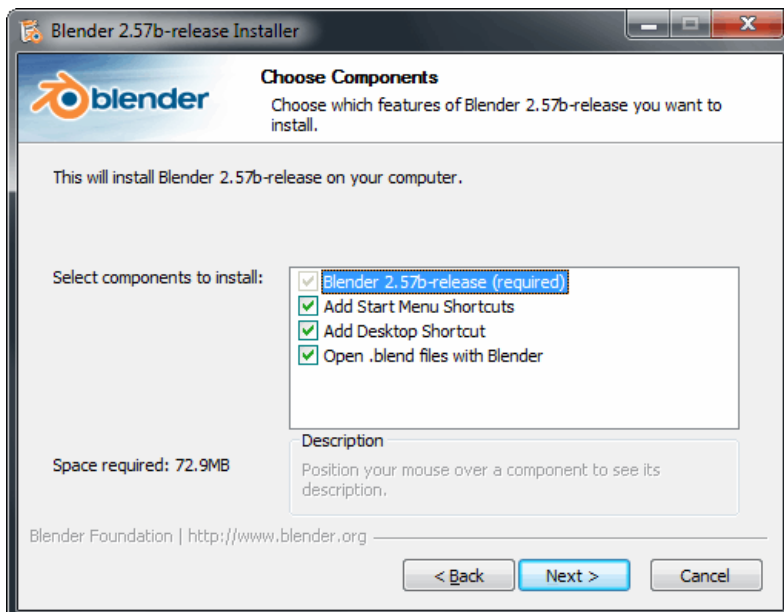
License agreement



The License agreement must be accepted before the installation will continue.

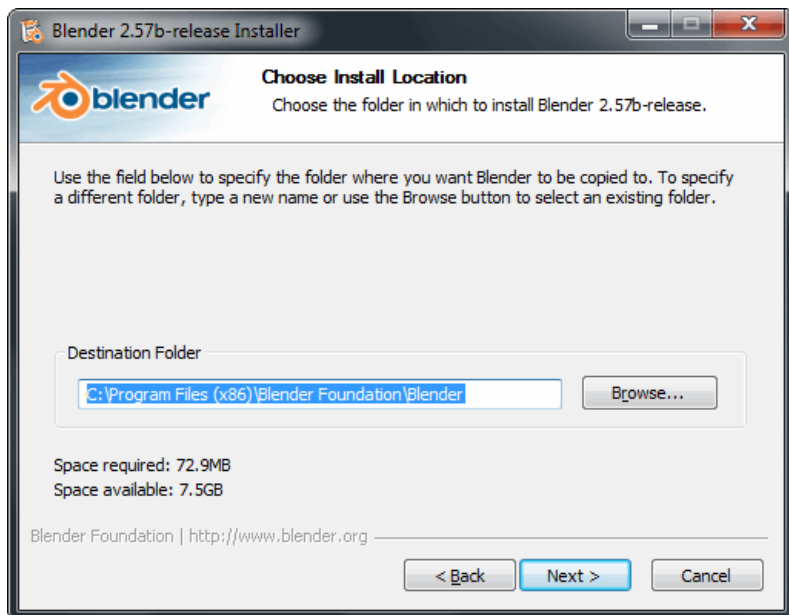
Installation options

Program options



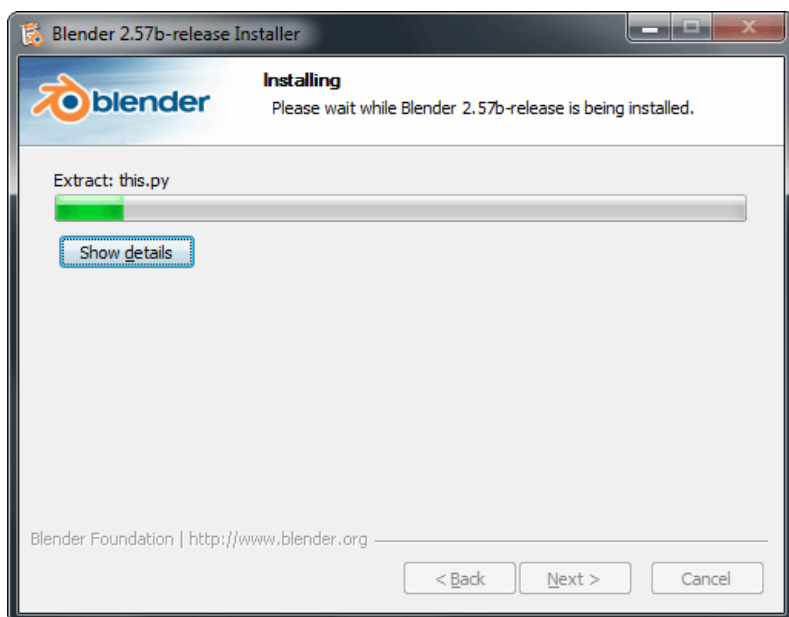
Select any desired options.

Location

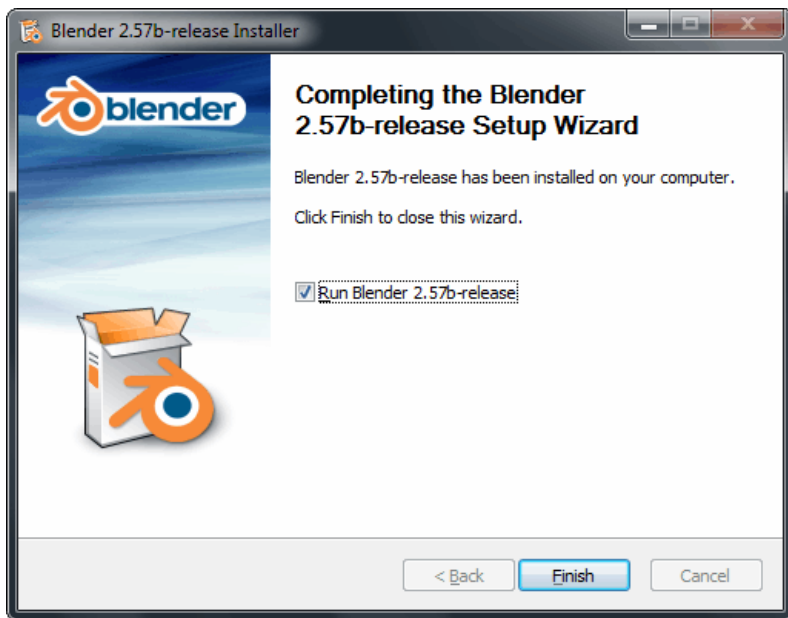


Here you can choose the directory where Blender will be installed.

Installing



Installed



And there you go! A fresh installation of Blender 2.5. After enabling or disabling the option to run Blender right after closing the installation, click 'Finish'.

Portable Install

If you want to run Blender off a USB key so that you can use it wherever you go, download the .zip version and extract it to a USB key. You may want to avoid storing animation output or other temporary files on the USB key as frequent drive writes may shorten its life.

To keep all configuration files and installed addons on the USB key, create a folder named *config* in the unzipped Blender folder. Now all configuration files will be read from and written to the USB key rather than the computer you're running Blender on.

Installing on Linux

Download

You can obtain the latest stable version of Blender for Linux from the [Blender download page](#) or from your distribution software repository if it provides a Blender package.

Version

Blender for Linux is currently available in 32-bit and 64-bit versions. Users with a 32-bit version of Linux must download the 32-bit version of Blender. Users with a 64-bit version of Linux can choose to use either the 32-bit or 64-bit version of Blender, however you will likely notice an increase in performance when using the 64-bit version of Blender, especially on systems with large amounts of RAM.

To determine whether you have a 32-bit or 64-bit version of Linux, you can either consult your distributions' documentation or use the `uname` command with the `-m` option. `uname` will print system information and the `-m` option will print the machine hardware name.

- Open a terminal console
- Enter the command `uname -m`

If you have a 32-bit system, `uname -m` will return a value of `i686`. A 64-bit system will return a value of `x86_64`.

Distribution releases

Most major distributions such as Ubuntu, Debian, Open SUSE, Fedora and many others will provide a build of Blender in their software repository that can be accessed through that distributions package manager. If your distribution does not do this, or has not updated their repository to include the latest Blender release, you can install it yourself with the instructions below.

Note that Distribution Releases typically are very old and outdated.

Installation

First check if your distribution provides the latest Blender version through its package manager. If it doesn't, download the appropriate version of Blender for Linux from the [Blender download page](#) and unpack the archive to a location of your choice.

This will create a directory named `blender-VERSION-linux-glibcVERSION-ARCH`, where `VERSION` is the Blender release version, `glibcVERSION` is the version of glibc required and `ARCH` is your computer architecture (`i686` or `x86_64`). In this directory you will find the `blender` binary.

To run Blender,


- Start your [X.Org server](#) (if it is not already running)
- Navigate to the Blender directory using a file manager and double click the Blender executable or,
- Open a terminal console, navigate to the Blender directory and execute the command `./blender`

Installing into `/opt` or `/usr/local`

You can also install Blender into `/opt` or `/usr/local` by moving the Blender directory into one of those locations. If you want to be able to run Blender from any directory you will also need to update your `PATH` variable. Consult your operating system documentation for the recommended method of setting your `PATH`.

Configuration

Alt+Mouse Conflict

Many Linux distributions default to `Alt LMB`  for moving windows, since blender uses `Alt+Click` its normally easiest to disable this feature or change the key to Super (Windows Key)

- Ubuntu 11.04: Settings > Window Manger Tweak > Accessibility > Change Window Key to Super
- todo - others

Compositing Desktop Environments

Many recent Linux distributions enable compositing when hardware support is available, This is a feature where the graphics card is used to do window drawing and accelerated desktop effects (drop shadow & window transparency for example).

Notably - Ubuntu Unity, Gnome Shell and KDE will use compositing.

While many users find this works flawlessly, some graphics cards have buggy drivers which cause drawing glitches with Blender but work correctly for regular applications which don't use OpenGL acceleration.

Another downside to using hardware accelerated desktop effects is the windows you have open share texture memory with blenders OpenGL display and GPU rendering.

If you experience these problems they can be avoided by disabling desktop effects or by switching to a desktop environment which does not use desktop effects.

To disable compositing try turn off desktop effects, or if this option isn't available you can switch to a desktop environment where it is:

- Unity2D
- Gnome Fallback
- XFCE
- light weight window managers like openbox, jwm, sawfish, icewm... etc.

For details on this topic, see: [Wikipedia - Compositing Window Managers](#)

Page status ([reviewing guidelines](#))



Page reviewed and in good shape

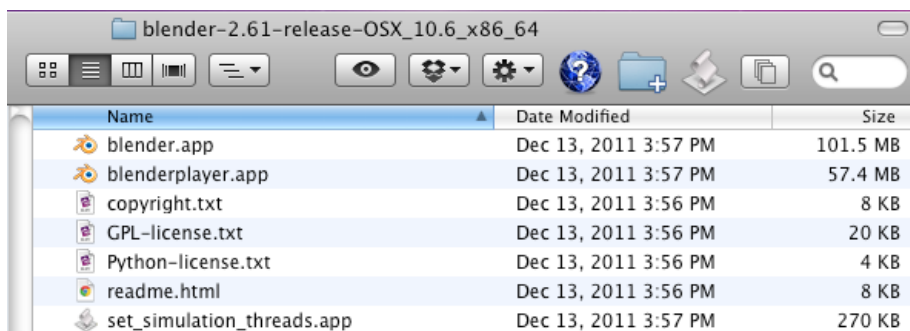
Installing on Mac

Installing Blender on a Mac is very easy. There are pre-compiled versions for PowerPC Processors and for 32 and 64 Bit Macs using Intel Processors. Once you know your platform and processor :



Blender Unzipped (left) and Zipped (right)

- Download the appropriate Blender for your system from [blender.org download page](#)
- Click/Right Click RMB  in the Downloaded file, choose *Unzip to a Folder*.
- A Folder where you downloaded Blender will be created, with the same name of the downloaded file, without extension.
- Click in the folder, it will be opened in Finder (See Fig: Opening Blender From Finder - Below)
- Click twice LMB  in *blender.app* file. You're ready to go !



Opening Blender from Finder - Example using Blender 2.61 for 64 bits Intel Mac, Mac OS X 10.6

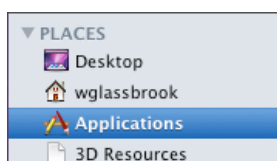


Supported Platforms for Blender 2.6X and above

Blender 2.6X Versions and above will only run in Computers with PowerPC G5 processors or Macs using Intel processors, Mac OS X 10.5 or higher is required.

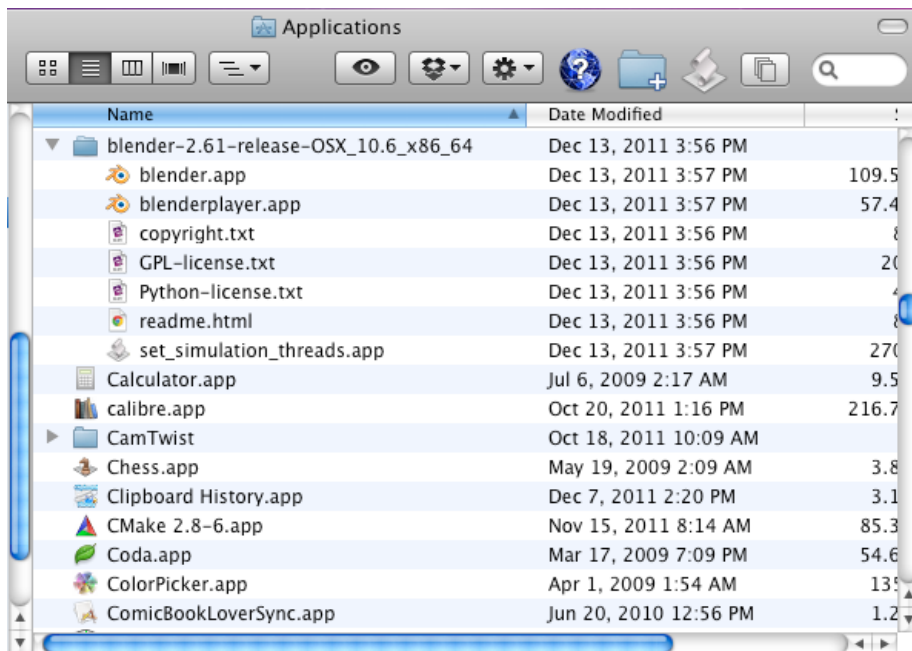
Important: If you need to run Blender from a Command Line to see the Console Window, visit the page about the [Blender Console Window](#)

Adding Blender to Applications



Places and Applications on Mac


You can move Blender to the Mac OS X *Applications* folder, it will work like any other application in your Mac. You can do this copying or moving the unzipped folder to the Mac *Applications* folder. Find the *Applications* folder, using the Finder File Browser and searching for *Places*. At the left side, opening the *Places* Tab, you will find your *Applications* folder. Move the Unzipped Blender Folder to the Applications.



Blender, when moved to Applications folder

Adding Blender to your Dock

To add Blender to your dock, you can do the following:

- When Blender is placed in your *Applications* folder, click in *blender.app* and drag it to your dock.
- While Blender is running, right click RMB  on the icon present in your Mac Dock, choose *Keep in Dock*.

Other supported operating systems

FreeBSD

Download the file `blender-2.##-FreeBSD-####.tbz` from the [Blender download page](#) where 2.## is the Blender version and #### is the machine architecture (i386 or amd64).

To start Blender

- Unpack the archive
- Open a shell and navigate to the unpacked archive's directory
- Execute the command `./blender` while the [X.Org server](#) is running.

Other unsupported operating systems

MorphOS

Ports for this platform are maintained by Guillaume Roguez. More information about this port can be found at [his wiki \(french version\)](#).

Installation of this port requires you to unpack the archive to a location on your hard drive rather than to [RAM](#) as Python wont be able to use its dynamic .pym modules from RAM.

Post Install Configuration

Blender will normally run fine without _any_ configuration but there are some changes you may want to make depending on you're hardware.

This section **only** covers system specific user preferences.



Info

The key combination CtrlU saves all the settings of the currently open Blender file into the default Blender file. The settings in the default Blender file are read when Blender is first started or when CtrlN is pressed to start a new file. If you accidentally change the settings in your default Blender file (i.e. you save your work in progress as the default) you can restore factory settings from the file menu press CtrlU to save the newly loaded factory settings.

The following section titles match the user preference categories.

Input

- If you don't have a numpad you may want to enable 'Emulate Numpad'
- If you don't have a middle mouse button you can enable 'Emulate 3 Button Mouse'

File Paths

This isn't essential but you may want to set the paths for more useful default locations.

- Temp Directory: You may want to change this if you have a faster disk for temp file storage.
- Image Editor: Useful so you can exit images externally (from the image space), The path to the gimp for example can be set here.



Info

"/" at the start of a path in blender signifies the directory of the currently opened blend file, used to reference relative-paths.

System

While there are many settings here you may want to set in special-cases, this document focuses on common features.

- VBOs (Vertex Buffer Objects), can give a good speed boost to the viewport performance, keep this enabled unless it gives problems (some older hardware does not support VBOs)

Sequence / Clip Editor:

- Memory Cache Limit: If you use the sequencer of movie clips you may want to increase the cache limit since this will make scrubbing a lot faster - but take care the limit stays well under your total system memory.

Configuration & Data Paths

Blender can be installed system wide or run from an extracted bundle with all necessary files contained.

There are 3 different directories blender may use, their exact locations are operating system dependent.

- **LOCAL:** location of configuration and runtime data (for self contained bundle)
- **USER:** location of configuration files (normally in the user's home directory).
- **SYSTEM:** location of runtime data for system wide installation (may be read-only).

For system installations both **SYSTEM** & **USER** directories are needed.

For locally extracted blender distributions the user configuration and data runtime data are kept in the same sub-directory, allowing multiple blender versions to run without conflict, ignoring the **USER** and **SYSTEM** files.

Here are the default locations for each system:

OSX

LOCAL: ./2.64/

USER: /Users/{user}/Library/Application Support/Blender/2.64/

SYSTEM: /Library/Application Support/Blender/2.64/

note, OSX stores blender binary in ./blender.app/Contents/MacOS/blender, so the local path to data & config is ./blender.app/Contents/MacOS/2.64

Windows

LOCAL: .\2.64\

USER: C:\Documents and Settings\{username}\AppData\Roaming\Blender Foundation\Blender\2.64\

SYSTEM: C:\Documents and Settings\All Users\AppData\Roaming\Blender Foundation\Blender\2.64\

Unix (Linux/BSD/Solaris)

LOCAL: ./2.64/

USER: \$HOME/.config/blender/2.64/

SYSTEM: /usr/share/blender/2.64/

note that ./2.64/ is relative to the blender executable & used for self contained bundles distributed by official blender.org builds.

note the USER path will use XDG_CONFIG_HOME if its set: \$XDG_CONFIG_HOME/blender/2.64/

Path Layout

This is the path layout which is used within the directories described above.

Where ./config/**startup.blend** could be ~/.blender/2.64/config/startup.blend for example.

- ./autosave/ ...
autosave blend file location. *Windows only, temp directory used for other systems.*
search order: **LOCAL, USER**
- ./config/ ...
defaults & session info
search order: **LOCAL, USER**
- ./config/**startup.blend**
default file to load on startup.
- ./config/**bookmarks.txt**
file selector bookmarks.
- ./config/**recent-files.txt**
recent file menu list.
- ./datafiles/ ...
runtime files
search order: **LOCAL, USER, SYSTEM**
- ./datafiles/locale/{language}/
language translations. *not currently in use!*
- ./datafiles/icons/*.png
icon themes for blenders user interface. *not currently selectable in the theme preferences.*

- `./datafiles/brushicons/*.png`
images for each brush.
- `./scripts/ ...`
python scripts for the user interface and tools
search order: **LOCAL, USER, SYSTEM**
- `./scripts/addons/*.py`
python addons which may be enabled in the user preferences, includes import/export format support, render engine integration and many handy utilities.
- `./scripts/addons/modules/*.py`
modules for addons to use (added to python's `sys.path`)
- `./scripts/addons_contrib/*.py`
another addons directory which is used for community maintained addons (must be manually created).
- `./scripts/addons_contrib/modules/*.py`
modules for addons_contrib to use (added to python's `sys.path`)
- `./scripts/modules/*.py`
python modules containing our core API and utility functions for other scripts to import (added to python's `sys.path`)
- `./scripts/startup/*.py`
scripts which are automatically imported on startup.
- `./scripts/presets/{preset}/*.py`
presets used for storing user defined settings for cloth, render formats etc.
- `./scripts/templates/*.py`
example scripts which can be accessed from: Text Space's Header -> Text -> Script Templates
- `./python/ ...`
bundled python distribution only necessary when the system's python is absent or incompatible
search order: **LOCAL, SYSTEM**

Notes

User Scripts Path

The user preferences script path provides a way to set your own directory which is used for scripts as well as the user scripts path. Be sure to create subfolders within this directory which match the structure of blender's scripts directory, `startup/`, `addons/`, `modules/` etc. because copying scripts directly into this folder will not load them on startup or as addons.

Environment Variables

Environment variables can be used to override default path locations, eg: `$BLENDER_USER_CONFIG`, `$BLENDER_SYSTEM_PYTHON`.

This is not normally something which needs setting but can be useful for custom configurations.

For details see the 'Environment Variables' section in 'blender --help'

Scripts Path & Missing Buttons

If blender starts with no interface this is probably because the scripts are not loading correctly and can be caused by...

- script path not found.
- an error in one of the scripts.
- a version mis-match between blender and the scripts.

It's best to load blender from a terminal to see any error messages to see what's wrong.

Starting Blender for the first time

If you are familiar with Blender 2.4x or other 3D software such as Maya, 3ds Max or XSI, you will immediately notice that Blender is quite different than what you are used to seeing. However you will soon see similarities with your previous software like a 3D Viewport, an Outliner and a Timeline. If this is the first time you have used any 3D software, you may be a little lost. Fortunately there's really only one rule when you want to learn 3D with Blender: don't be afraid to explore and experiment!

After starting Blender, take a look at the splash screen where you will see the Blender version in the top right-hand corner.



The left side shows you some useful links like the [release log](#) of the version you are using (what's new in this version), [the wiki manual](#) (what you're reading now) and the [official Blender website](#). These links are also accessible from the Help menu. The right side lists recent blender files (.blend) you have saved. If you're running Blender for the first time, this part will be empty. This list is also available in File » Open Recent. The interaction menu lets you choose a keymap preset (by default, Blender or Maya) are available.

To start using Blender, you have three options:

- Click on one of the recent files (if you have any)
- Click anywhere else on the screen (except the dark area of the splash screen) or
- Press Esc to start a new project

Save your work regularly

Blender does not warn you of any unsaved data when you exit the program, so remember to save often! If you do close Blender without saving your last actions, all is not lost. Just open Blender again and click on Recover Last Session in the Splash Screen. You also have this option in the main menu via File » Recover Last Session.

Temporary .blend file

Every time Blender exits, it saves the current data in a temporary .blend file. When you recover your last session, Blender will load the data from that file.

Interface concepts



Blender is developed as cross-platform software which means that it works on Linux, Mac OS X and Windows. Since the Blender interface is based on [OpenGL](#), you will find that it is consistent between the major operating systems.

The 3 rules

The Blender user interface is based on 3 main principles:

- **Non Overlapping:** The UI permits you to view all relevant options and tools at a glance without pushing or dragging windows around⁽¹⁾.
- **Non Blocking:** Tools and interface options do not block the user from any other parts of Blender. Blender doesn't pop up requesters that require the user to fill in data before things execute.
- **Non Modal:** User input should remain as consistent and predictable as possible without changing commonly used methods (mouse, keyboard) on the fly.

⁽¹⁾However, Blender 2.5 permits multiple windows for multi-screen setup. It is an exception to the *Non overlapping rule*.

Powerful interface



Blender's interface is drawn entirely in [OpenGL](#) which allows you to customize your interface to suit your needs. Windows and other interface elements can be panned, zoomed and its content moved around. Your screen can be organized exactly to your taste for each specialized task which can then be named and saved.

Blender also makes heavy use of keyboard shortcuts to speed up your work. The keymaps can be edited to make memorizing them easier.

Overview

Let's have a look at the default interface. It is composed of Editors, Headers, Context buttons, Panels, and Controls.

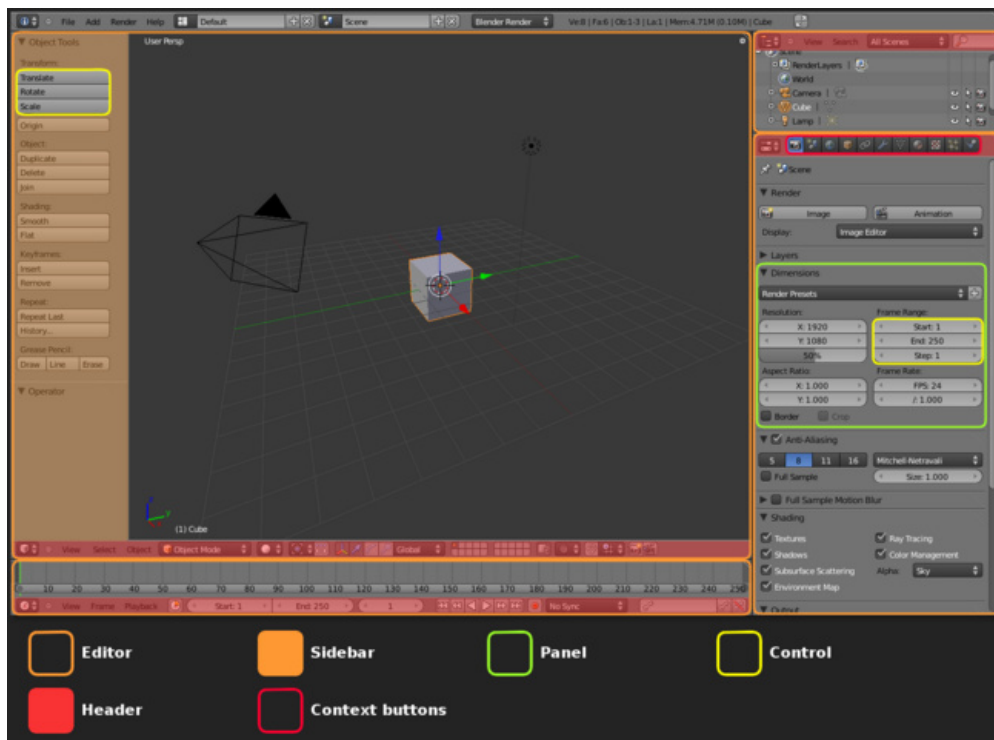
- In Blender, we call the **Editor** the part of the software which has a specific function (3D view, Properties Editor, Video Sequence Editor, Nodes Editor...). Each editor has its own *Header* at the top or bottom.
- **Context buttons** give access to options. They are like tabs and are often placed on an editor header (like Properties Editor).
- On each editor, options are grouped in **Panels** to logically organize the interface (Shadow panel, Color panel, Dimensions panel...).
- **Sidebars** are included in some editors. In that case, panels and controls are grouped there. For workspace optimization, it is possible to temporarily hide sidebars.
- Panels contain **Controls**. These can let you modify a function, an option, or a value. In Blender, there are several types of controls :
 - **Buttons:** Permit access to a tool (Translate, Rotate, Insert Keyframe). These tools usually have a keyboard shortcut to speed up your work. To display the shortcut, just hover your mouse over a button to see the tooltip.
 - **Checkboxes:** Permit enabling or disabling of an option. This control can only contain a boolean value (True/False, 1/0).
 -

Sliders: Allows you to enter floating values. These can be limited (From 0.0 to 100.0) or not (From $-\infty$ to $+\infty$). Notice that two types of sliders exist in Blender.

○

Select menus: Permits a value to be chosen from a list. The difference between this and a Checkbox is that values are named and there can be more than two values on these menus.

[Read more about buttons and controls »](#)



This chapter gives an overview of the general mouse and keyboard usage in Blender and the conventions used in this Manual to describe them, as well as tips on how to use non-standard devices.

Input configuration

Blender's interface is designed to be used with the following recommended input configuration:

- A three-button mouse with a wheel
- A full keyboard with a numeric keypad
- NumLock should generally be switched on.


If you do not have the recommended configuration (i.e., you are using a laptop), it is possible to change the Blender user preferences to emulate it.


[Read more about Blender configuration »](#)


Conventions in this Manual

This manual uses the following conventions to describe user input:

- The mouse buttons are called:


LMB  - left mouse button

MMB  - middle mouse button and

RMB  - right mouse button.

- If your mouse has a wheel

MMB  - refers to clicking the wheel as if it were a button, while

Wheel  - means rolling the wheel.

- Hotkey letters are shown in this manual like they appear on a keyboard; for example,

G - refers to the lowercase "g".

⇧ Shift, Ctrl and Alt are generally specified as modifier keys

CtrlW or ⇧ ShiftAltA - indicates that these keys should be pressed simultaneously

0 NumPad to 9 NumPad, + NumPad - and so on refer to the keys on the separate numeric keypad.

Other keys are referred to by their names, such as Esc, ⇐ Tab, F1 to F12. Of special note are the arrow keys, ←, → and so on.

General Usage

Because Blender makes such extensive use of both mouse and keyboard, a golden rule has evolved among Blender users: **Keep one hand on the mouse and the other on the keyboard**. The most frequently used keys are grouped so that they can be reached by the left hand in standard position (index finger on F) on the English keyboard layout. This assumes that you use the mouse with your right hand.










If you normally use a keyboard that is significantly different from the English keyboard layout, you may want to think about changing to the English or American layout for your work with Blender. Note that you can also change the Blender default keymap and change the default hotkeys. However this manual is based on the default keymap.




[Read more about Blender configuration »](#)

Mouse Button Emulation

If you do not have a 3 button mouse, you'll need to emulate it by checking the option in the [User Preferences](#) (unchecked by default).

The following table shows the combinations used:

3-button Mouse		2-button Mouse	Apple Mouse
LMB 	LMB 	LMB  (mouse button)	
MMB 	Alt LMB 	⌥ Opt LMB  (Option/Alt key + mouse button)	
RMB 	RMB 	⌘ Cmd LMB  (Command/Apple key + mouse button)	

All the Mouse/Keyboard combinations mentioned in the Manual can be expressed with the combinations shown in the table. For Example, ⌘ ShiftAlt RMB  becomes ⌘ ShiftAlt  Cmd LMB  on a single-button mouse.

NumPad Emulation

[Read more about NumPad Emulation on User Preferences page »](#)

Page status ([reviewing guidelines](#))

Page reviewed and in good shape

The Window System

When you start Blender you should a screen similar to this (the splash screen in the center will change with new versions):



In the center of the window is the splash screen. This gives quick and easy access to recently opened Blender files. If you want to start work on a new file just click outside of the splash screen. The splash screen will disappear revealing the default layout and cube.

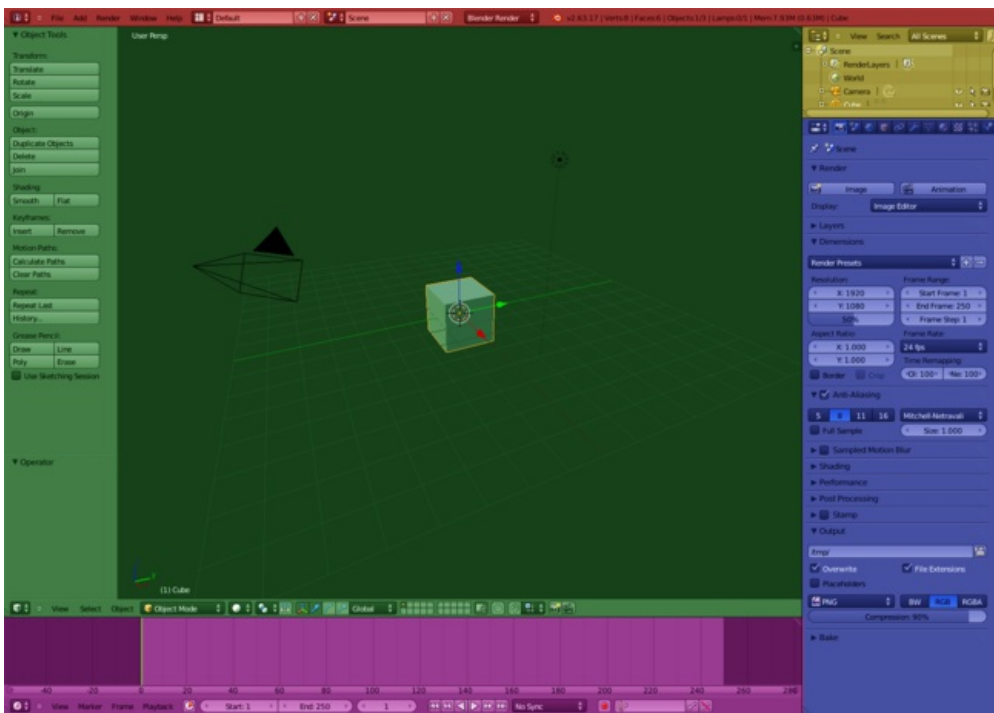
Every window you see can be further broken down into separate areas (as described in the section on [arranging frames](#)). The default scene is described below.

The default scene

The default scene is separated into five windows and is loaded each time you start Blender or a new file. The five windows are:

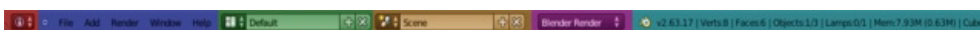
- The Info window (shaded red) at the top. The Info window is comprised solely of a header.
- A large 3D window (3D View) (shaded green).
- A Timeline window at the bottom (shaded purple).
- An Outliner window at the top right (shaded yellow).
- A Properties window (Buttons window) at the bottom right (shaded blue).

As an introduction we will cover a few of the basic elements.



Default Blender scene and Window arrangement

The Info Window (main menu)



Info Window

The Info Window is found at the top of the Default Scene and has the following components:

- **Window/Editor Type Selector:** The red shaded area allows you to change the [Window/Editor Type](#). This region is found on every Window.
- **Menu options:** The dark blue shaded area provides access to the main menu options.
- **Current Screen (default is Default):** The green shaded area allows you to select different [Screens](#). By default, Blender comes with several pre-configured Screens for you to choose from. If you need custom screen layouts, you can create and name them.
- **Current Scene:** The yellow shaded area allows you to select different [Scenes](#). Having multiple Scenes allows you to work with separate virtual environments, with completely separate data, or with objects and/or mesh data linked between them. (In some 3D packages, each file contains one scene, while in Blender, one .blend file may contain several scenes).
- **Current Engine:** The purple shaded area gives a list of available rendering and game engines.
- **Resource Information:** The aqua shaded area gives you information about Blender and system resources in use. This region will tell you how much memory is being consumed based on the number of vertices, faces and objects in the selected scene, as well as totals of what resources are currently selected. This can help identify when you are reaching the limits of your hardware.

3D Window View



- **3D Cursor:** Can have multiple functions. For example, it represents where new objects appear when they are first created, or it can represent where the center of a rotation will be.



- **3D Transform Manipulator:** Is a visual aid in transforming objects (grab/move, rotate and scale). Objects can also be transformed using the keyboard shortcuts: (G/R/S); CtrlSpace will toggle the manipulator visibility.
- **Cube Mesh:** By default, a new installation of Blender will always start with a Cube Mesh sitting in the center of Global 3D space (in the picture above, it has been moved). After a while, you will most likely want to change the "Default" settings; This is done by [configuring Blender](#) as you would want it on startup and then saving it as the "Default" using CtrlU (Save Default Settings).



- **Light (of type Lamp):** By default, a new installation of Blender will always start with a Light source positioned somewhere close to the center of Global 3D space.



- **Camera:** By default, a new installation of Blender will always start with a Camera positioned somewhere close to the center of Global 3D space and facing it.

3D Window Header



3D Window Header

This is the header for the 3D window. All windows in Blender have a header, although in some cases they may be located at bottom of the window.

Read more about [Blender headers »](#)



- **Window/Editor Type Selector:** Allows you to change the [type of Window](#). This option can be found in every window header. For example, if you want to see the Outliner window you would click and select it.



- **3D Transform manipulator options:** Access to the [manipulator](#) widget is also possible by clicking the coordinate system icon on the toolbar. The translation/rotation/scale manipulators can be displayed by clicking each of the three icons to the right of the coordinate system icon. ⇧ Shift LMB -clicking an icon will add/remove each manipulator's visibility.



- **Viewport shading:** Blender renders the 3D window using [OpenGL](#). You can select the type of [Viewport shading](#) that takes place by clicking this button and selecting from a variety of shading styles including simple bounding boxes and complex textures. It is recommended that you have a powerful graphics card if you are going to use the Textured style.



- **Layers:** Blender [Layers](#) are provided to help distribute your objects into functional groups. For example, one layer may contain a water object and another layer may contain trees, or one layer may contain cameras and lights. To de-clutter the view you can turn layers on and off.

Buttons (Properties) Window Header



Properties Window Header

The Properties window displays panels of functions. Panels that contain similar functions are grouped e.g. all of the rendering options are grouped. In the header of the Properties Windows is a row of buttons (called Context Buttons) that allow you to select which group of panels are shown. Some panels are only visible when particular Objects are selected. Panels can be collapsed by use of the small arrow left of the panel title (e.g. besides *Render*) and may be rearranged by dragging the top right corner.

Outliner Window



Outliner Window Header

This window lists all the objects in a scene and can be very useful when working with larger scenes with lots of items. You can choose what types of elements and how they are displayed in the header.

Timeline Window



Timeline Window Header

This window gives a timeline, through which you can scrub with the LMB .

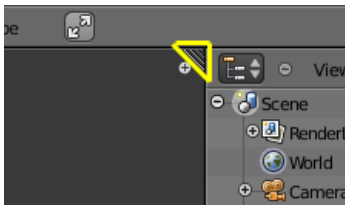
Arranging frames

Blender uses a novel screen-splitting approach to arrange window frames. The application window is always a rectangle on your desktop. Blender divides it up into a number of re-sizable window frames. A window frame contains the workspace for a particular type of window, like a 3D View window, or an Outliner. The idea is that you split up that big application window into any number of smaller (but still rectangular) non-overlapping window frames. That way, each window is always fully visible, and it is very easy to work in one window and hop over to work in another.

Maximizing a window

You can maximize a window frame to fill the whole application window with the View → Toggle Full Screen menu entry. To return to normal size, use again View → Toggle Full Screen. A quicker way to achieve this is to use ⇧ ShiftSpace, Ctrl↓ or Ctrl↑ to toggle between maximized and framed windows. NOTE: The window your mouse is currently hovering over is the one that will be maximized using the keyboard shortcuts.

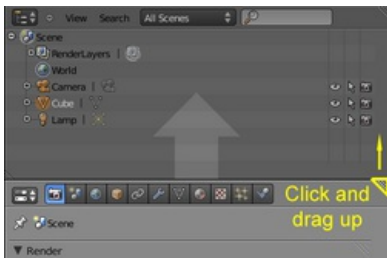
Splitting a window



In the upper right and lower left corners of a window are the window splitter widgets, and they look like a little ridged thumb grip. It both splits and combines window panes. When you hover over it, your cursor will change to a cross. LMB and drag it to the left to split the pane vertically, or downward to split it horizontally.

Joining two frames

In order to merge two window frames, they must be the same dimension in the direction you wish to merge. For example, if you want to combine two window frames that are side-by-side, they must be the same height. If the one on the left is not the same as the one on the right, you will not be able to combine them horizontally. This is so that the combined window space results in a rectangle. The same rule holds for joining two window frames that are stacked on top of one another; they must both have the same width. If the one above is split vertically, you must first merge those two, and then join the bottom one up to the upper one.



To merge the current window with the one above it (in the picture the properties window is merged "over" the Outliner), hover the mouse pointer over the window splitter. When the pointer changes to a cross, LMB click and drag up to begin the process of combining. The upper window will get a little darker, overlaid with an arrow pointing up. This indicates that the lower (current) frame will "take over" that darkened frame space. Let go of the LMB to merge. If you want the reverse to occur, move your mouse cursor back into the original (lower) frame, and it will instead get the arrow overlay.

In the same way, windows may be merged left to right or vice versa.

If you press Esc before releasing the mouse, the operation will be aborted.

Changing window size


You can resize window frames by dragging their borders with LMB. Simply move your mouse cursor over the border between two frames until it changes to a double-headed arrow, and then click and drag.

Swapping contents

You can swap the contents between two frames with Ctrl LMB on one of the splitters of the initial frame, dragging towards the target frame, and releasing the mouse there. Those two frames don't need to be side by side, though they must be inside the same window.

Opening new windows

You may wish to have a new full window containing Blender frames. This can be useful, for instance, if you have multiple monitors and want them to show different information on the same instance of Blender.

All you need to do is ⇧ LMB  on a frame splitter, and drag slightly. A new window pops up, with its maximize, minimize, close and other buttons (depending on your platform), containing a single frame with a duplicate of the initial window on which you performed the operation.

Once you have that new window, you can move it to the other monitor (or leave it in the current one); you can resize it (or keep it unchanged); you can also arrange its contents in the same way discussed so far (split and resize frames, and tune them as needed), and so on.

There is, though, another way to get an extra window: *File* → *User Preferences...* (or CtrlAltU) pops a new window also, with the *User Preferences* window in its only frame. You can then proceed the same way with this window.

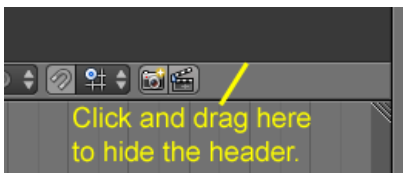
Window Headers

All windows have a header (the strip with a lighter grey background containing icon buttons). We will also refer to the header as the window *ToolBar*. The header may be at the top (as with the Properties Window) or the bottom (as with the 3D Window) of a window's area. The picture below shows the header of the 3D window:



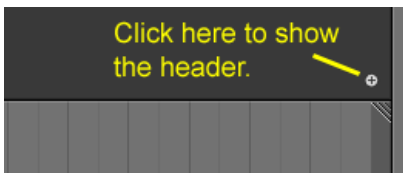
If you move the mouse over a window, its header changes to a slightly lighter shade of grey. This means that it is "focused". All hotkeys you press will now affect the contents of this window.

Hiding a header



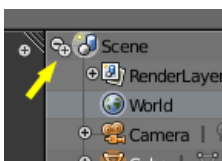
To hide a header, move your mouse over the thin line between a window and its header, until the pointer takes the form of an up-down-arrow. Then click, hold and drag with LMB from the window over the header to hide the latter.

Showing a header



A hidden header leaves a little plus-sign (see picture). By LMB this, the header will be reappear.

Note 1: In the 3D window there are up to two more of these little plus signs (to the top left and right of the window). Those will open panels with several tools, not a second header.



Note 2: In some windows, the mentioned plus sign can be hard to find, because it might look like a part of other icons. One example is the Outliner, in which there are other such plus signs, thus giving the one to get the header back good camouflage.

Header position


To move a header from top to bottom or the other way round, simply RMB on it and select the appropriate item from the popup menu. If the header is at the top, the item text will read "Flip to Bottom", and if the header is at the bottom the item text will read "Flip to Top".




Theme colours

Blender allows for most of its interface color settings to be changed to suit the needs of the user. If you find that the colors you see on screen do not match those mentioned in the Manual then it could be that your default theme has been altered. Creating a new theme or selecting/altering a pre-existing one can be done by selecting the [User Preferences](#) window and clicking on the Themes tab of the window.

Window type button

With the LMB  clicking on the first icon at the left end of a header allows selection of one of the 16 different window types. Every window frame in blender may contain any type of window. So if you want 3D views everywhere, just go ahead and change them all.

Menus and buttons

Most Window Headers, located immediately next to this first "Window Type" Menu button, exhibit a set of menus which can be hidden - again with a little minus sign. So if you cannot find a menu that was mentioned somewhere, try looking for a little plus sign (once again) next to the "Window Type" button. By clicking LMB  on it, the menu will come back.

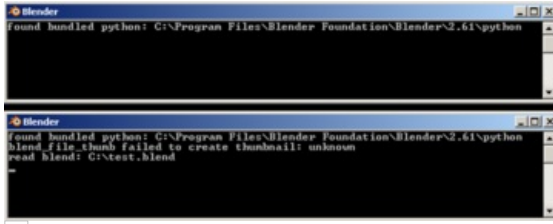
Menus allow you to directly access many features and commands, so just file through them to see what's there. All Menu entries show the relevant shortcut keys, if any.

Menus and buttons will change with Window Type and the selected object and mode. They only show the actions that can be performed.

The Console Window

The Console Window is an operating system text window that displays messages about Blender operations, status, and internal errors. If Blender crashes on you, the Console Window may be able to indicate the cause.

Windows XP/Vista/7



The Blender Console Window on Windows XP and subsequent messages.

When Blender is started on a Windows operating system, the Console Window is first created as a separate window on the desktop. Assuming that the right start-up conditions are met, the main Blender window should also appear and the Console Window will then be toggled off. To display the console again, go to Help » Toggle System Console.

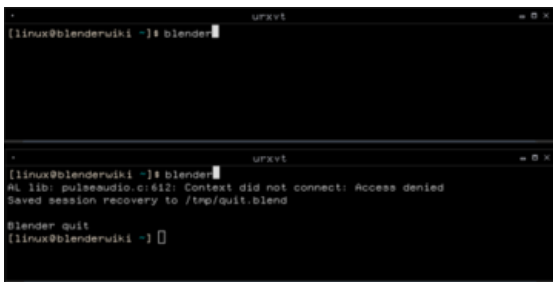
The screenshot on the right shows the Blender Console Window on Windows XP directly after starting Blender and then a short while later after opening a file along with the relevant messages.



Closing the Blender Console Window

The Blender Console Window must remain open while Blender is running. Closing the Console Window will also close Blender and you will lose any unsaved work. MS-DOS windows and the Blender Console Window can look very similar, so always make sure that you are closing the correct window.

Linux



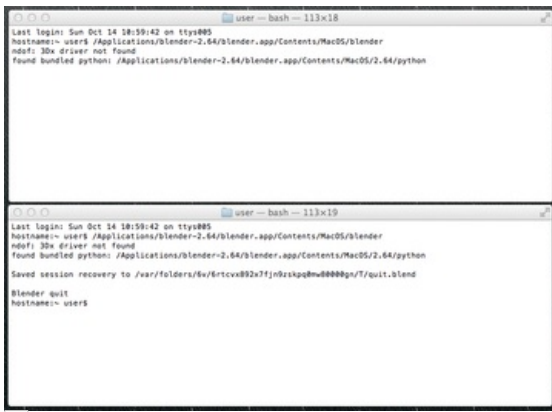
Starting Blender from a Linux console window and subsequent messages.

The Blender Console Window in Linux will generally only be visible on the Desktop if Blender is started from a Linux Terminal/Console Window as Blender uses the Console Window it is started from to display Console output.

Depending on your Desktop Environment setup, a Blender icon may appear on your desktop or an entry for Blender added to your menu after you install Blender. When you start Blender using a Desktop icon or menu entry rather than a Terminal window, the Blender Console Window text will most likely be hidden on the Terminal that your [XWindows](#) server was started from.

This screenshot shows Blender started from a Linux Terminal/Console Window and the resulting console text being printed to it. This example shows that when Blender was started it was unable to access a library related to the Pulseaudio sound server. When Blender closed, it saved the recovery file to `/tmp/quit.blend`.

MacOS



```
user -- bash -- 113x18
Last login: Sun Oct 14 18:59:42 on ttys005
hostname: users /Applications/blender-2.64/blender.app/Contents/MacOS/blender
ndf: 3Dx driver not found
Found bundled python: /Applications/blender-2.64/blender.app/Contents/MacOS/2.64/python

user -- bash -- 113x19
Last login: Sun Oct 14 18:59:42 on ttys005
hostname: users /Applications/blender-2.64/blender.app/Contents/MacOS/blender
ndf: 3Dx driver not found
Found bundled python: /Applications/blender-2.64/blender.app/Contents/MacOS/2.64/python
Saved session recovery to /var/folders/6w/6rtcv882x7fjn9zskp0m08000gp/T/quit.blend
Blender quit
hostname: users
```

Starting Blender from a Mac OS X console window and subsequent messages.

The process in MacOS is very similar to the one described for Linux. MacOS uses "files" with the .app extension called *applications*. These files are actually folders that appear as files in Finder. In order to run Blender you will have specify that path to the blender executable inside this folder, to get all output printed to the terminal. You can start a terminal from Applications -> Utilities. The path to the executable in the .app folder is `./blender.app/Contents/MacOS/blender`.

If you have blender installed in the Applications folder, the following command could be used, adapted to the particular blender version: `/Applications/blender-2.64/blender.app/Contents/MacOS/blender`

Console Window Status and Error Messages

The Blender Console Window can display many different types of Status and Error Messages. Some messages simply inform the user what Blender is doing, but have no real impact on Blender's ability to function. Other messages can indicate serious errors that will most likely prevent Blender carrying out a particular task and may even make Blender non-responsive or shutdown completely. The Blender Console Window messages can also originate internally from within the Blender code or from external sources such as [Python scripts](#).

Common messages

- found bundled python: (FOLDER)

This message indicates that Blender was able to find the [Python](#) library for the Python interpreter embedded within Blender. If this folder is missing or unable to be found, it is likely that an error will occur, and this message will not appear.

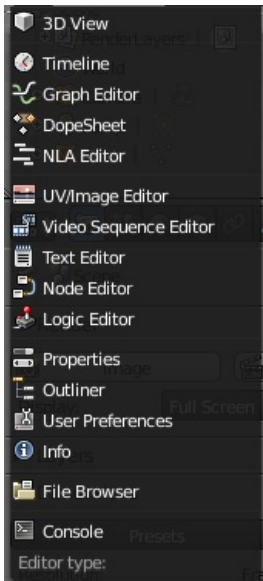
- malloc returns nil()

When Blender carries out operations that require extra memory (RAM), it calls a function called malloc (short for memory allocate) which tries to allocate a requested amount of memory for Blender. If this cannot be satisfied, malloc will return nil/null/0 to indicate that it failed to carry out the request. If this happens Blender will not be able to carry out the operation requested by the user. This will most likely result in Blender operating very slowly or shutting down. If you want to avoid running out of memory you can install more memory in your system, reduce the amount of detail in your Blender models, or shut down other programs and services which may be taking up memory that Blender could use.

Page status ([reviewing guidelines](#))

Page reviewed and in good shape

Window Types



The Window Type selection menu.

The Blender interface is divided up into many rectangular Window Frames. Each Window Frame may contain different types of information, depending upon the Window Type.

Each Window Frame operates independently of the others, and you can have the same Window Type in many frames. For example, you may have several 3D windows open but each looking at the Scene from a different perspective. You can split and merge and resize Window Frames to suit whatever you are working on. You can also arrange some Window Frames to display without a Header to save screen space.

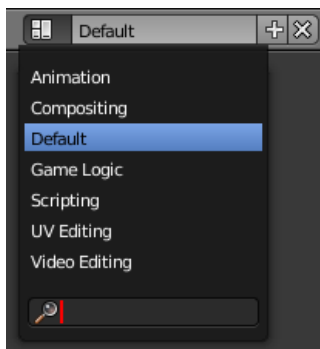
[Read more about arranging frames »](#)

Window Types are broken up by functionality:

- [The 3D View](#)- a graphical view of your scene.
- [The Timeline](#) - Controls for animation playback.
- [The Graph Editor](#) - manage animation keys (and drivers) and inter/extrapolation of these.
- [The Dope Sheet](#) - combine individual actions into action sequences.
- [The NLA Editor](#) - manage non-linear animation action sequences.
- [The Image/UV Editor](#) - an image editor with advanced UV management tools.
- [The Video Sequence Editor](#) - assemble video sequences into a film strip.
- [The Text Editor](#) - keep notes and documentation about your project, and write Python scripts.
- [The Node Editor](#) - allows you to use nodes for texturing, materials and compositing.
- [The Logic Editor](#) -a game logic editing window.
- [The Properties Editor](#) - shows the several attributes of the currently selected object.
- [The Outliner](#) - Helps you find and organize your objects.
- [User Preferences](#) - customize Blender to your work style and computer.
- [The Info Window](#) - provides information and options for managing files, windows and engines.
- [The File Browser](#) - used to organize, load and save files (most times invoked automatically, when needed).
- [The Console](#) - to directly use python in Blender.

You can select the Window Type by clicking the Window Header's *leftmost* button. A pop-up menu displays showing the available Window Types.

Screens



Layout dropdown

Blender's flexibility with windows lets you create customized working environments for different tasks such as modeling, animating, and scripting. It is often useful to quickly switch between different environments within the same file.

To do each of these major creative steps, Blender has a set of pre-defined *screens*, that show you the types of windows you need to get the job done quickly and efficiently. *Screens* are essentially pre-defined window layouts. If you are having trouble finding a particular screen, you can use the search function at the bottom of the list (pictured right).

Default Screens available

Animation

Making actors and other objects move about, change shape or color etc.

Compositing

Combining different parts of a scene (i.e. background, actors, special effects) and filter them (i.e. color correction)

Default

The default layout used by Blender for new files. Useful to model new objects

Game Logic

Planning and Programming of games within Blender

Scripting

Documenting your work and/or writing custom scripts to automate Blender

UV Editing

Flattening a projection of an object mesh in 2D to control how a texture maps to the surface

Video Editing

Cutting and editing of animation sequences

Blender sorts these screen layouts for you automatically in alphabetical and/or numerical order. The list is available in the Info Window header that is at the top of the layout for preset screens. This is often confused for a menu bar by those new to Blender, however it is simply a window showing only its header.

To change to the next alphabetically listed screen press Ctrl→; to change to the previous screen, press Ctrl←.



Screen and Scene selectors

By default, each screen layout 'remembers' the last [scene](#) it was used on. Selecting a different layout will switch to the layout **and** jump to that scene.

All changes to windows, as described in [Window system](#) and [Window types](#), are saved within one screen. If you change your windows in one screen, other screens won't be affected.


Configuring your Screens

Adding a new Screen

Click on the "Add" button(+) and a new frame layout will be created based on your current layout.


You might want to give the new screen not only a *name* but also a *number* in front of it so that you can predictably scroll to it using the arrow keys. You can rename the layout by LMB in the field and typing a new name, or clicking again to position the cursor in the field to edit. For example you could use the name "6-MyScreen". See *Screen and Scene selectors* above.

Deleting a Screen

You can delete a screen by using the Delete datablock button () . See *Screen and Scene selectors* above.

Rearranging a Screen

Use the [window controls](#) to move frame borders, split and consolidate windows. When you have a layout that you like, press CtrlU to update your User defaults. Be aware that all of the current scenes become part of those defaults, so consider customizing your layouts with only a single, simple scene.

The properties window has a special option: pressing RMB  on its background will allow you to arrange its panels horizontally or vertically. Of the two, vertically arranged panels have greater support.

Overriding Defaults

When you save a .blend file, the screen layouts are also saved in it. When you open a file, enabling the Load UI checkbox in the file browser indicates that Blender should use the file's screen layouts (overriding your defaults in the process). Leaving the Load UI checkbox disabled tells Blender to use the current layout.

Additional Layouts

As you become more experienced with Blender, consider adding some other screen layouts to suit your workflow as this will help increase your productivity. Some examples could include:

1-Model

Four 3D windows (top, front, side and perspective), Properties window for Editing

2-Lighting

3D windows for moving lights, UV/Image Window for displaying Render Result, Properties window for rendering and lamp properties and controls

3-Material

Properties window for Material settings, 3D window for selecting objects, Outliner, Library script (if used), Node Editor (if using [Node based materials](#))

4-UV Layout

UV/Image Editor Window, 3D Window for seaming and unwrapping mesh

5-Painting

UV/Image Editor for texture painting image, 3D window for painting directly on object in UV Face Select mode, three mini-3D windows down the side that have background reference pictures set to full strength, Properties window

6-Animation

Graph Editor, 3D Window for posing armature, NLA Window

7-Node

Big Node Editor window for noodles, UV/Image window linked to Render Result

8-Sequence

Graph Editor, video sequence editor in Image Preview mode, video sequence editor in timeline mode, a Timeline window, and the good old Properties window.

9-Notes/Scripting

Outliner, Text Editor (Scripts) window

Reuse your Layouts

If you create a new window layout and would like to use it for future .blend files, simply save it as the User default by pressing CtrlU (don't forget: all screens and scenes themselves will be saved as default too).

Scenes

Scenes are a very useful tool for managing your projects. The Cube model in empty space you see when you open Blender for the first time is the default Scene. You can imagine Scenes to be similar to tabs in your web browser. For example, your web browser can have many tabs open at once. The tabs could be empty, showing identical views of the same web page, showing different views of the same page or show entirely different pages altogether. Blender's Scenes work in much the same way. You can have an empty Scene, a complete independent copy of your Scene or a new copy that links to your original Scene in a number of ways.

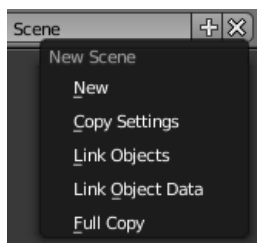
You can select and create scenes with the Scene selector in the Info window header (the bar at the top of most Blender layouts, see *Screen and Scene selectors*).




Screen and Scene selectors

Scene configuration

Adding a new Scene



Add Scene menu

You can add a new scene by clicking  in the Scene selector option. When you create a new scene, you can choose between five options to control its contents (*Add Scene menu*).

To choose between these options, you need to clearly understand the difference between "Objects" and "Object Data". Each Blender graphic element (Mesh, Lamp, Curve, *etc.*) is composed from two parts: an Object and Object Data (also known as ObData). The Object holds information about the position, rotation and size of a particular element. The ObData holds information about meshes, material lists and so on. ObData is common to every instance of that particular type of element. Each Object has a link to its associated ObData, and a single ObData may be shared by many Objects.

The five choices, therefore, determine just how much of this information will be *copied from* the currently selected Scene to the new one, and how much will be *shared* ("linked"):

New

Creates an empty Scene. In the new Scene, the Render Settings are set to the default values.


Copy Settings

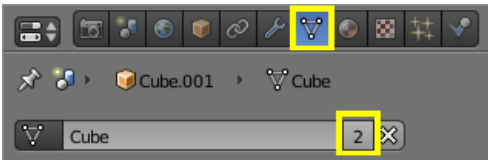
Creates an empty Scene like the previous option but also copies the Render Settings from the original Scene into the new one.

Link Objects

Is the shallowest form of copying available. This option creates the new Scene with the same contents as the currently selected Scene. However, instead of copying the Objects, the new Scene contains *links to* the Objects in the old Scene at the Object level. Therefore, changes in the *newScene* will result in the same changes to the *original* Scene because the Objects used are *literally* the same Objects. The reverse is also true (changes in the *old* Scene will cause the same changes in the *newScene*).

Link Object Data

Creates new, duplicate copies of all of the Objects in the currently selected Scene, but each one of those duplicate Objects will have *links to* the ObData (meshes, materials and so on) of the corresponding Objects in the original Scene. This means that you can change the position, orientation and size of the Objects in the new Scene without affecting other Scenes, but any modifications to the ObData (meshes, materials *etc.*) will also affect other Scenes. This is because a *single instance of* the "ObData" is now being shared by all of the Objects in all of the Scenes that link to it. If you want to make changes to an Object in the new Scene independently of the Objects in the other Scenes, you will have to manually make the object in the new Scene a "single-user" copy by LMB  the number in the Object Data panel of the [properties window](#). This has the effect of making a new independent copy of the ObData.



Full Copy

Is the deepest form of copying available. Nothing is shared. This option creates a fully independent Scene with copies of the currently selected Scene's contents. Every Object in the original Scene is duplicated, and a duplicate, private copy of its ObData is made as well.

To better understand the way Blender works with data, read through [Blender's Library and Data System](#).

A brief example

Consider a bar Scene in a film. You initially create the bar as a clean version, with everything unbroken and in its proper place. You then decide to create the action in a separate Scene. The action in your Scene will indicate which type of linking (if any) would suit your Scene best.

Link Objects

Every object will be linked to the original Scene. If you correct the placement of a wall, it will move in every Scene that uses the bar as a setting.

Link Object Data


Will be useful when the positions of Objects need to change, but their shape and material settings will remain constant. For example, chairs might stand on the floor in the "crowded bar" scene and up on the tables in the "we are closing" scene. Since the chairs don't change form, there is no need to waste memory on exact mesh-copies.

Full Copy

A glass shattering on the floor will need its own copy because the mesh will change shape.

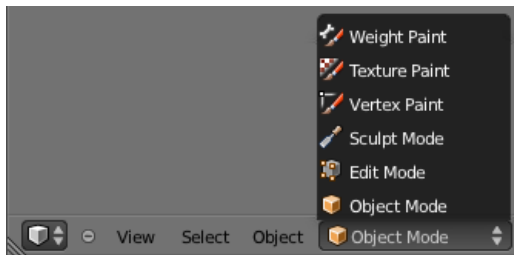
It is not possible to do all of the above in the same Scene, but it might help in understanding why to link different Objects in different ways.

Deleting a Scene

You can delete a scene by using the Delete datablock button () from the Scene selector option (see *Screen and Scene selectors*).

Modes

Modes are a Blender-level object-oriented feature, which means that *the whole Blender application* is always in *one and only one mode*, and that the available modes vary depending on the selected active object's type – most of them only enable the default Object mode (like cameras, lamps, etc.). Each mode is designed to edit an aspect of the selected object. See the (*Blender's Modes*) table below for details.



Mode selection example (mesh object).

You set the current mode in the Mode drop-down list of 3D View header (see *Mode selection example (mesh object)*).



You can only select objects in Object mode. In all others, the current object selection is “locked” (excepted, to some extent, with armature’s Pose mode).

Modes might affect many things in Blender:

- They can modify the panels and/or controls available in some Buttons window’s contexts.
- They can modify the behavior of whole windows, like e.g. the UV/Image Editor one (and obviously, 3D Views!).
- They can modify the available header tools (menus and/or menu entries, as well as other controls...). For example, in the 3D View window, the Object menu in Object mode changes to a Mesh menu in Edit mode (with an active mesh object!), and a Paint menu in Vertex Paint mode...

Blender’s Modes

Icon	Name	Shortcut	Remarks
	Object mode	<i>None</i> ¹	The default mode, available for all object types, as it is dedicated to Object datablock edition (i.e. position/rotation/size).
	Edit mode	⇧ Tab ¹	A mode available for all renderable object types, as it is dedicated to their “shape” ObData datablock edition (i.e. vertices/edges/faces for meshes, control points for curves/surfaces, etc.).
	Sculpt mode	<i>None</i> ¹	A mesh-only mode, that enables Blender’s mesh 3D-sculpting tool.
	Vertex Paint mode	<i>None</i> ¹	A mesh-only mode, that allows you to set your mesh’s vertices colors (i.e. to “paint” them).
	Texture Paint mode	<i>None</i> ¹	A mesh-only mode, that allows you to paint your mesh’s texture directly on the model, in the 3D views.
	Weight Paint mode	Ctrl⇧ Tab ²	A mesh-only mode, dedicated to vertex group weighting.
	Particle mode	<i>None</i> ¹	A mesh-only mode, dedicated to particle systems, useful with editable systems (hair).
	Pose mode	Ctrl⇧ Tab ²	An armature-only mode, dedicated to armature posing.

Notes about modes shortcuts:

1. ⇧ Tab toggles Edit mode.
2. Ctrl⇧ Tab switches between the Weight Paint (meshes)/Pose (armatures) modes, and the other current one (by default, the Object mode). However, the same shortcut has other, internal meanings in some modes (e.g. in Sculpt mode, it is used to select the current brush)...

As you can see, using shortcuts to switch between modes can become quite tricky, especially with meshes...

We won’t detail furthermore modes’ usages here. Most of them are tackled in the [modeling chapter](#), as they are mainly related to this topic. The Particle mode is discussed in the [particle section](#), and the Pose and Edit modes for armatures, in the [rigging one](#).

Note

If you are reading this manual and some button or menu option is referenced that does not appear on your screen, it may be that you are not in the proper mode for that option to be valid.










Contexts

The Properties (or Buttons) Window shows several Contexts, which can be chosen via the icon row in the header (see *Context button example*).



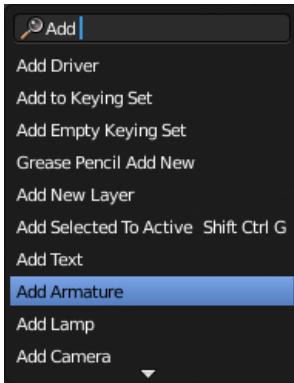
Context button example

The number and type of buttons changes with the selected Context so that only useful buttons show up. The order of these buttons follow a hierarchy which is detailed below:


-  [Render](#): Everything related to render output (dimensions, anti-aliasing, performance etc).
-  [Scene](#): Gravity in the scene, units and other general information.
 - [World](#): Environmental lighting, sky, mist, stars and Ambient Occlusion.
 - [Object](#): Transformations, display options, visibility settings (via layers) duplication settings and animation information (regarding Object position).
 -  [Constraints](#): Used to control an Object's transform (position, rotation, scale), tracking and relationship properties.
 -  [Modifiers](#): Operations that can non-destructively affect Objects by changing how they are rendered and displayed without altering their geometry (e.g. mirror and smoothing).
 -  Object Data: contains all Object specific data (color of a lamp, focal length of a camera, vertex groups etc). The icon differs with the type of Object (the one shown here is for a mesh object).
 -  [Materials](#): Information about a surface (color, specular, transparency, etc).
 -  [Textures](#): Used by materials to provide additional details (e.g. color, transparency, fake 3-dimensional depth).
 -  [Particles](#): Add variable amounts of (usually small) objects such as lights or mesh Objects that can be manipulated by Force Fields and other settings.
 -  [Physics](#): Properties relating to Cloth, Force Fields, Collision, Fluid and Smoke Simulation.


The [Buttons](#) in each context are grouped into [Panels](#).

Menus



The Space-menu

Blender contains many menus, each of which is accessible from either a window's header or directly at the mouse's location using [HotKeys](#) or by clicking RMB  on a window border, a button or elsewhere on the screen. A context sensitive menu will be displayed if there is one available for that interface element.

Additionally, a menu with access to all Blender commands is available by pressing Space (shown in the picture). Simply start typing the name of the command you need and let the search function of the menu do the rest. When the list is sufficiently narrowed, LMB  on the desired command or highlight it with ↓ and ↑ and select with Return.

If you miss the old tool box menu from version 2.4x, you can add something similar with the 3D View: Dynamic Spacebar Menu Add-On which can be installed from the Add-Ons tab of the Preferences window.

[Read more about installing Add-Ons »](#)

Some menus are context sensitive in that they are only available under certain situations. For example, the specials menu (W hotkey) is only available in a 3D window while Edit Mode is active.

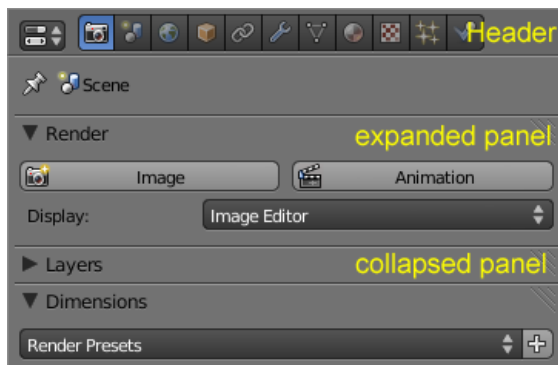
While you are using Blender, be aware of what mode is activated and what type of object is selected. This helps in knowing what hotkeys work at what times.



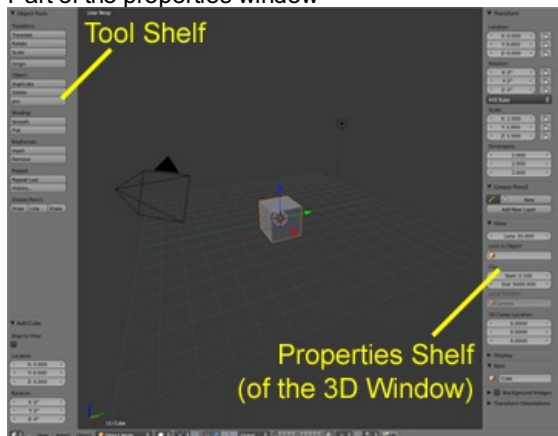
Menus on a Mac

Because Blender doesn't use the standard OS menu system, if you are using a Mac, you likely have a redundant menubar at the top. To remove it see [this post](#) on Macworld, but beware that it is somewhat complex. As an alternative: simply make Blender full screen with the last button in the info window header (most times at the top of the screen layout).

Panels



Part of the properties window




Shelves in a 3D Window





Panels generally appear in the Properties Window (Buttons Window in Version 2.4x), which can be found on the right hand side of the default screen layout (see *Part of the Properties window*).

Panels are also found on the Tool shelf and the Properties shelf which are toggleable parts of a 3D Window. To display the Tool shelf, use View » Tool or press T. To display the Properties shelf, use View » Properties or press N. See *Shelves in a 3D Window*.

The Properties Window includes the header to choose from several [Contexts](#). Each Context will have a different amount and type of Panels. For example the Render Context will have panels that allow you to alter the dimensions and anti-aliasing of the render output, while the Materials Context will have panels that allow you to set color, transparency, texture etc.

Panels in the Properties Window can be aligned vertically or horizontally by RMB  on the Properties Window and choosing the desired option from the menu. Note that the Panels in the Properties Window are optimised for vertical alignment. Horizontal alignment may be cumbersome to work with.

The placement and view of panels can also be altered to your preference. For example, panels can be:

- moved around the window (or shelf) by LMB  clicking, holding and dragging the widget in the upper right corner (this resembles the frame splitter widget and has three lines in a triangle formation).
- scrolled up and down by using Wheel 
- zoomed in and out by holding Ctrl MMB  and moving the mouse right and left .
- collapsed/expanded by LMB  clicking the solid black triangle on the left side of their header.

For further details about each panel see the [Panels](#) reference section, or find the appropriate section in the manual.


Buttons and Controls

Buttons and other controls can be found in almost every [Window](#) of the Blender interface. The different types of controls are described below.

Operation Buttons

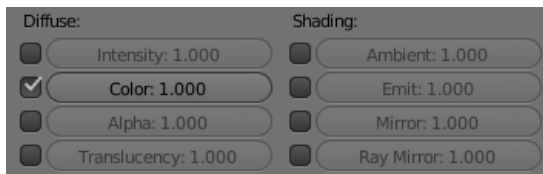


Operation button

These are buttons that perform an operation when clicked with LMB . They can be identified by their grey color in the default Blender scheme.

Pressing CtrlC over these buttons copies their python command into the clipboard which can be used in the python console or in the text editor when writing scripts.

Toggle Buttons



Toggle buttons

Toggle buttons consist of tick boxes. Clicking this type of button will toggle a state but will not perform any operation. In some cases the button is attached to a number button to control the influence of the property.

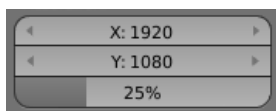
Radio Buttons



Radio buttons





Radio buttons are used to choose from a small selection of "mutually exclusive" options.

Number Buttons



Number buttons

Number buttons can be identified by their labels, which in most cases contains the name and a colon followed by a number. Number buttons are handled in several ways:

1. To change the value in steps, click LMB  on the small triangles on the sides of the button.
2. To change the value in a wider range, hold down LMB  and drag the mouse to the left or right. If you hold Ctrl after holding down LMB , the value is changed in discrete steps; if you hold ⇧ Shift instead, you'll have finer control over the values.
3. ↵ Enter or LMB  lets you enter the value by hand.

When entering values by hand, pressing ⌘ Home or → End will move the cursor to the beginning or the end of the range. Pressing Esc will cancel editing. You can copy the value of a button by hovering over it and pressing CtrlC. Similarly you can paste a copied value with CtrlV.

Expressions

You can also enter expressions such as $3*2$ instead of 6, or $5/10+3$. Even constants like π (3.142) or functions like $\text{sqrt}(2)$ (square root of 2) may be used.

These expressions are evaluated by python, for all available math expressions see: [math module reference](#)

Units

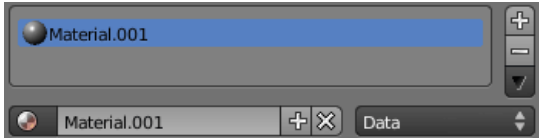
As well as expressions you can mix in units with numbers, for this to work, units need to be set in the scene settings (Metric or Imperial).

Valid units include...

- 1cm
- 1m 3mm
- 1m, 3mm
- 2ft
- 3ft/0.5km
- 2.2mm + 5' / 3" - 2yards

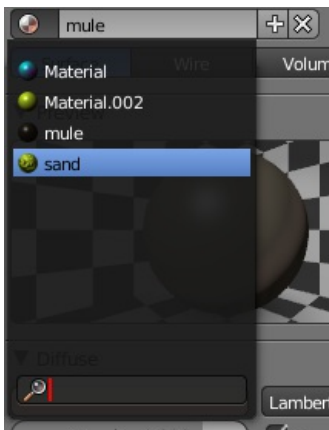
Note that the comma's are optional, also notice how you can mix between metric and imperial even though the display can only show one at a time.

Menu Buttons





Datablock link buttons




Use the Menu buttons to work with items on dynamically created lists. Menu buttons are principally used to link DataBlocks to each other. DataBlocks are items like Meshes, Objects, Materials, Textures, and so on. Linking a Material to an Object will assign that material to the selected Objects.



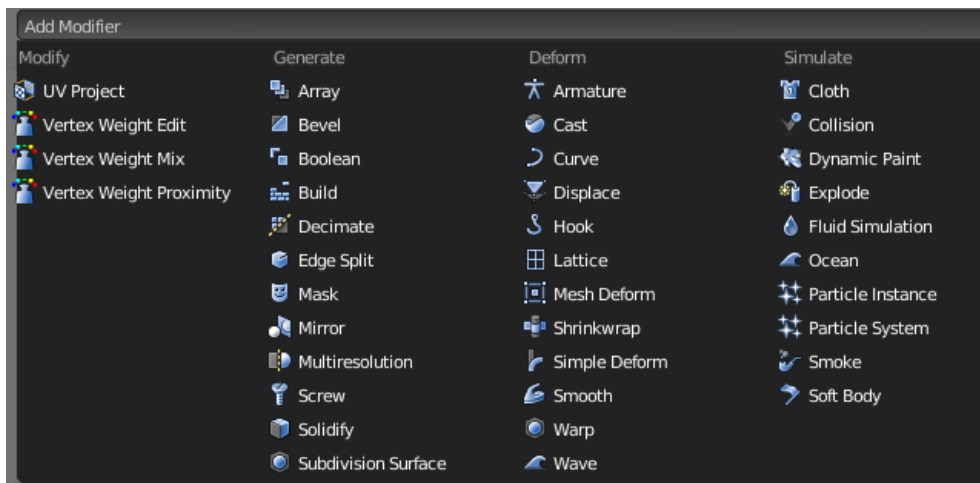
Datablock link menu with search

1. The first button (with an icon of the DataBlock type) opens a menu that lets you select the DataBlock to link by clicking LMB  on the requested item. This list has a search box at the bottom.
2. The second button displays the name of the linked DataBlock and lets you edit it after clicking LMB .
3. The "+" button duplicates the current DataBlock and applies it.
4. The "X" button clears the link.

Sometimes there is a list of applied DataBlocks (such as a list of materials used on the object. See *DataBlock link buttons* above.

1. To select a datablock click LMB  on it.
2. To add a new section (eg material, particle system etc.) click LMB  on the "+" button to the right of the list.
3. To remove a section click LMB  on the "-" to the right of the list.

Another type of a Menu button block will show a static list with a range of options. For example, the Add Modifier button will produce a menu with all of the available modifiers.



Modifier options

Unlinked objects

Unlinked data is ***not* lost until you quit Blender**. This is a powerful Undo feature. If you delete an object the material assigned to it becomes unlinked, but is still there! You just have to re-link it to another object or supply it with a "Fake User" (i.e. by clicking that option in the corresponding DataBlock in the datablock-view of the outliner)

[Read more about Fake User »](#)

Color Selector Controls

Some controls pop-up a dialog panel. For example, Color controls will pop up a Color Selector dialog when clicked. See *Color Selector*.




Color Selector

- ← Backspace resets the color to its default.
- Mouse wheel changes the brightness.

Eye Dropper

The eye dropper allows you to sample from anywhere in the blender window.

LMB  and dragging the eyedropper will mix the colors you drag over which can help for sampling noisy imagery. Spacebar resets and starts mixing the colors again.

Cascade Buttons

Occasionally, some buttons actually reveal additional buttons. For example, the Ramps panel has a Cascade button called Ramp that reveals additional buttons dealing with colorbanding. See *Colorband before* and *Colorband after*.



Colorband before



Colorband after

Page status ([reviewing guidelines](#))

Page reviewed and in good shape

Blender Internationalization

From version 2.60, Blender supports international fonts and a range of language options for the Interface and Tooltips. To enable it, open the User Preferences window, System tab, and toggle the International Fonts option in the bottom right-hand corner.

This displays three new settings:



Enabling international fonts in the User Preferences window.

Language

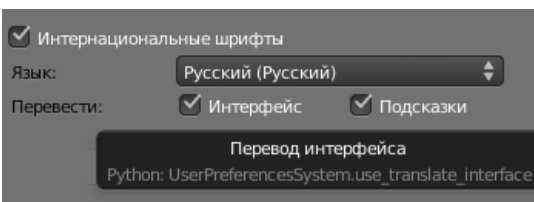
drop-down menu where you can select your preferred language.

Interface

to translate the User Interface itself (e.g. controls and menus).

Tooltips

to translate tooltips.



Blender with the Russian language enabled for the Interface and Tooltips.

Blender refreshes the screen after selecting Interface or Tooltips (or both) to show the new language. Note that some language translations are not yet complete. The progress of each translation is indicated in the drop-down menu.



Tip

Since the majority of tutorials are done with an English User Interface, it may be useful to keep the User Interface in English and only translate the tooltips.

Page status ([reviewing guidelines](#))

Page reviewed and in good shape

Quick Rendering

What is rendering ?

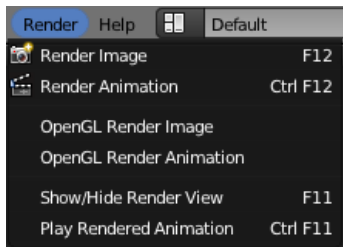
Rendering is the process of creating a 2D image. Blender creates this image by taking into account your model and all of your materials, textures, lighting and compositing.

- There are two main types of rendering engines built inside Blender, one for *Full render*, and other for *OpenGL render*. This page shows you basic knowledge about rendering Images. For a deeper knowledge about the *Full Render Engine* built inside Blender, called Blender Internal, consult the section about [Rendering with Blender Internal](#).
- There is also a Section in this wiki Manual, dedicated to the new [Cycles](#) Render Engine, built in Blender since Version 2.61.

Rendering an image using *Full Render* - Blender Internal

Mode: All modes

Hotkey: F12



Header of the Info Window

To start a *Full render* using Blender Internal you can do any of the following options:

- Press F12
- Go to Properties Window » Render context » Render panel and press the Image button or
- Go to Render » Render Image from the header of the Info Window (See: *Header of the Info Window*)
- Using Blender Search, pressing Space, typing Render and clicking on Render.

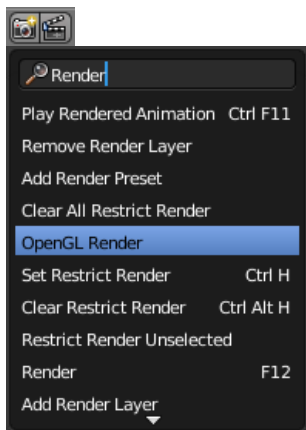
To abort or quit the render, press Esc.

Rendering an image using *OpenGL Render*

Mode: All modes

Hotkey: Undefined -You can add one for your [Keymap »](#)

To start a *OpenGL render* you can do any of the following options:



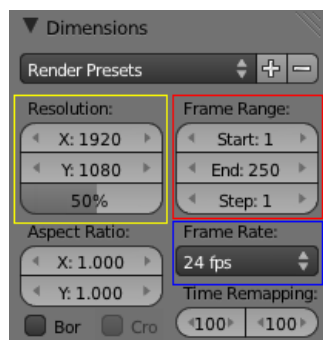
Search functionality

- Click on *OpenGL Render Active Viewport*, in the header of the 3D Window, using the small button showing a *Camera* (together with a small image showing a *slate*) in the header of the 3D View
- Go to Render » OpenGL Render Image from the header of the Info Window (See: *Header of the Info Window*Image)

- Using Blender Search, pressing Space, typing *Render* and clicking on OpenGL Render.

To abort or quit the render, press Esc.

Adjusting the resolution



Dimensions panel

The Dimensions panel of the Render context allows you to change the resolution. The default installation of Blender, is set initially to **50%** of **1920 x 1080**, resulting in an **960 x 540** Image. (Highlighted in Yellow, in Dimensions Panel Image). Higher resolutions and high percentage scales will show more detail, but will also take longer to render.

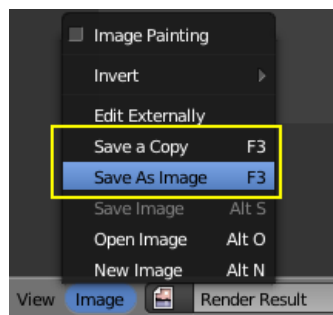
Output format and output file



Output panel

You can also choose an output format and the output location for your rendered image or animation. By default those are saved in a temporary folder (/tmp), using an absolute path. You can setup your file paths using instructions present in the [File setup chapter](#), however you can change this to a different folder by clicking the folder icon in the Output panel. You can also choose the type of image or movie format for your work from the Menu Button

Saving your image



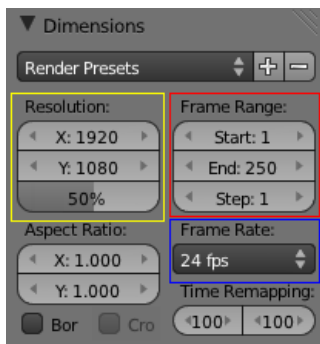
Save as dialog

Blender does not save your image automatically. To save your image, you can either press F3 or click Save As Image from the Image menu of the UV/Image editor window's header. This action will open the Blender Internal File Browser, and then you can search for folders to place your Render.

Rendering an animation using *Full Render* - Blender Internal

Mode: All modes

Hotkey: CtrlF12



Dimensions panel

Rendering an animation is simple, the Frame Range (Highlighted in Red, in Dimensions Panel Image) in the Output Panel is used to define the **amount of frames** your animation will render. The **time** is defined by the *Frames Per Second*, defined in the Frame Rate (Highlighted in Blue, in Dimensions Panel Image) drop-down list. The standard is set to **24 FPS** and **250** frames.

A quick example to understand those numbers:

- The Panel shows that the animation will start at frame **1** and ends at frame **250**, and the FPS setting is set to **24**, so, the standard Blender installation will give you approximately **10** (ten) seconds of animation ($250 / 24 = 10.41$ sec).

To render an animation using *Full Render* with the Blender Internal Engine, you can do any of the following options:

- Press Ctrl+F12
- Go to Properties Window » Render context » Render panel and press the Animation button or
- Go to Render » Render animation from the header of the Info Window (See: *Header of the Info Window* Image)

To abort or quit rendering the animation, press Esc.

Rendering an animation using *OpenGL Render*

Mode: All modes

Hotkey: Undefined - You can add one for your [Keymap](#) »

To Render an animation using *OpenGL Render*, you can do any of the following options:



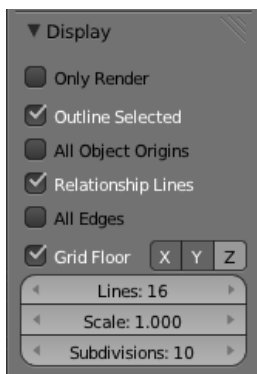
- Click on the small button showing a *slate* (together with a small image showing a *camera*) in the header of the 3D View
- Go to Render » OpenGL Render animation from the header of the Info Window (See: *Header of the Info Window* Image)

To abort or quit rendering the animation, press Esc.

Showing Only Rendered Objects

Mode: All modes

Hotkey: Undefined - You can add one for your [Keymap](#) »



Transform Panel -
Display Tab.

At render time (either Full or OpenGL), there are some Objects in the scene that won't be rendered, either because of their type (Bones, Empties, Cameras, etc.), because they are void or have no visible geometry (Mesh without any vertex, curves not extruded, etc.), or simply because they are set as not renderable.

Blender has an option to only show Objects in the Scene that will be rendered.

To access this option, point your Mouse to the 3D View (focusing on it), use the shortcut N or click in the + signal in the upper right side, to show the Transform Panel. Rolling through the options, you will find the Display tab, which options are for controlling how the Objects are displayed in the 3D View.

Just enable Only Render option - now, only Objects that will be rendered will be shown (see Fig: Transform Panel - Display Tab). This option also works when generating Images using OpenGL Render. Note that all of the other options for selective displaying will be disabled.

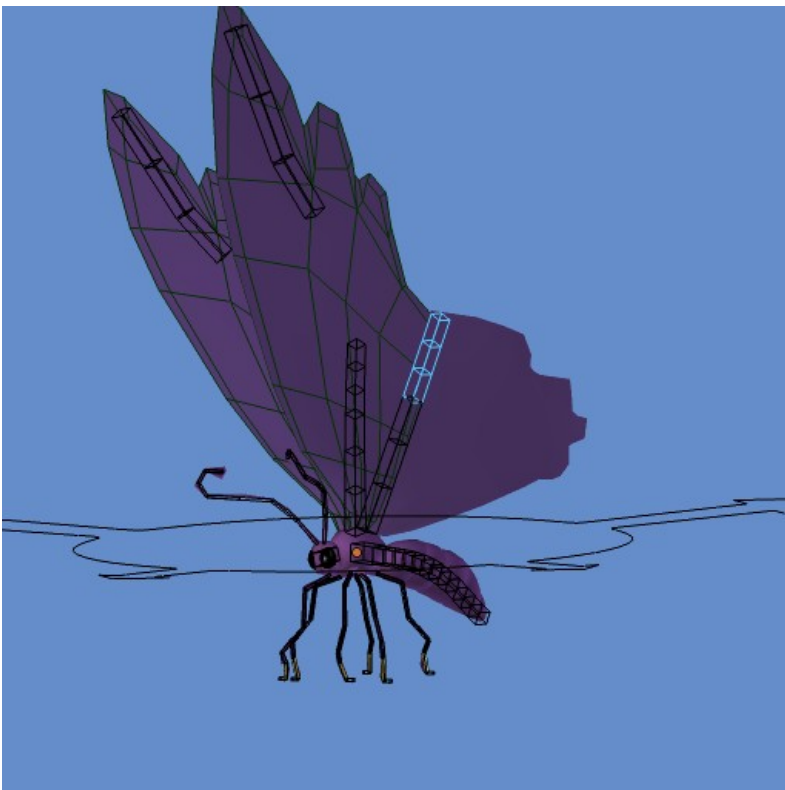
The purposes of OpenGL Rendering

OpenGL rendering allows an animator to quickly inspect his animatic (for things like object movements, alternate angles, etc.), by giving him a draft quality rendering of the current viewport.

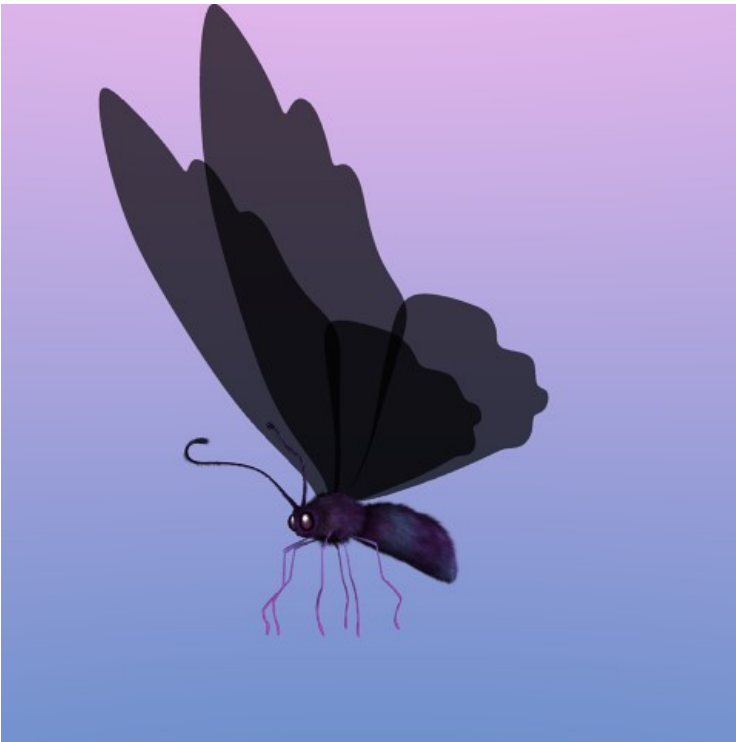
Because it is only rendered using OpenGL, it is much faster to generate, even if it only looks as good as what you see on the 3D viewport.

This allows the animator to preview his animation with fluid playback, when he would otherwise not be able to do so in realtime due to scene complexity (ie: Pressing AltA results in too low of a *Frames Per Second* to get a good feel for the animation).

This is an example of an OpenGL rendered image:



And then here is the *Full Render* using Blender Internal render engine:



You can use OpenGL to render both images and animations, and change dimensions using the same instructions explained above. As with a normal render, you can abort it with Esc.

Recovering from mistakes or problems

Blender provides a number of ways for the user to recover from mistakes, and reduce the chance of losing their work in the event of operation errors, computer failures, or power outages. There are two ways for you to recover from mistakes or problems:

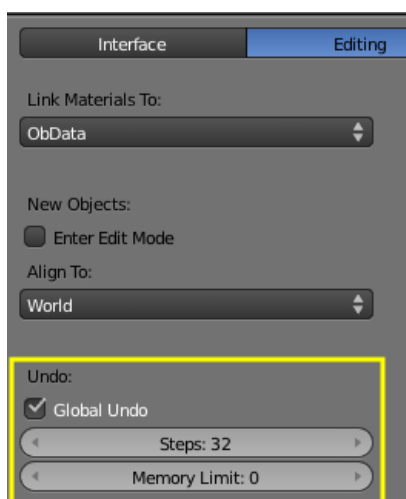
At the [User Level](#) (Relating to Actions)

- For your actions, there are options like Undo, Redo and an Undo History, used to roll back from mistakes under normal operation, or return back to a specific action.
- Blender also has new features like Repeat and Repeat History, and the new Redo Last which you can use in conjunction with the options listed.

At the [System Level](#) (Relating to Files)

- There are options to save your files like Auto Save that saves your file automatically over time, and Save on Quit, which saves your Blender file automatically when you exit Blender. Note: In addition to these functions being enabled by default, the Save on Quit functionality cannot be disabled.

Options for Actions (User Level)



Undo options

The commands listed below will let you roll back an accidental action, redo your last action, or let you choose to recover to a specific point, by picking from a list of recent actions recorded by Blender. Two new features that were added to the Blender 2.5x series, are the Repeat and Repeat History commands.

To enable or disable Undo, go to the User Preferences window and click on the Editing tab. In this section you can set:

Global Undo

This enables Blender to save actions done when you are **not** in Edit Mode. For example, duplicating Objects, changing panel settings or switching between modes. The default Blender Installation comes with the option *Global Undo* enabled by default.

Steps

This numeric field indicates how many steps or actions to save. The default value of **32** will allow you to Undo the last thirty-two actions that you performed. You can change this numeric field to the maximum of **64**.

Memory Limit

This numeric field allows you to define the maximum amount of memory in Megabytes that the Undo system is allowed to use. The default value of **0** indicates no limit.

Undo

Mode: All modes

Hotkey: CtrlZ

Like most programs, if you want to undo your last action, just press CtrlZ

Redo

Mode: All modes

Hotkey: ⇧ ShiftCtrlZ

To roll back your Undo action, press ⇧ ShiftCtrlZ

Redo Last

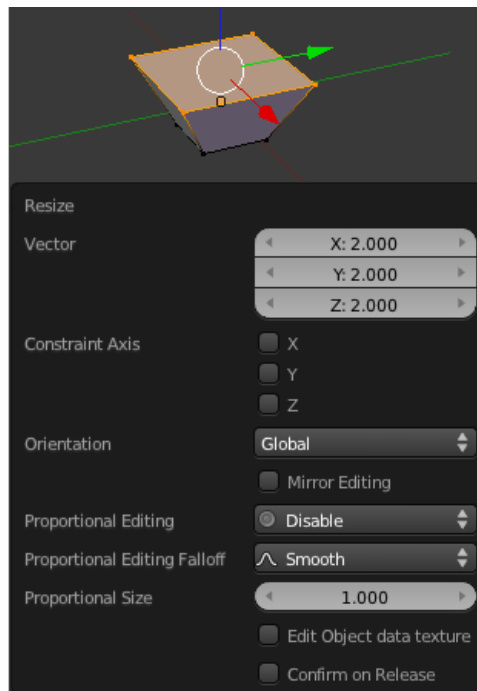
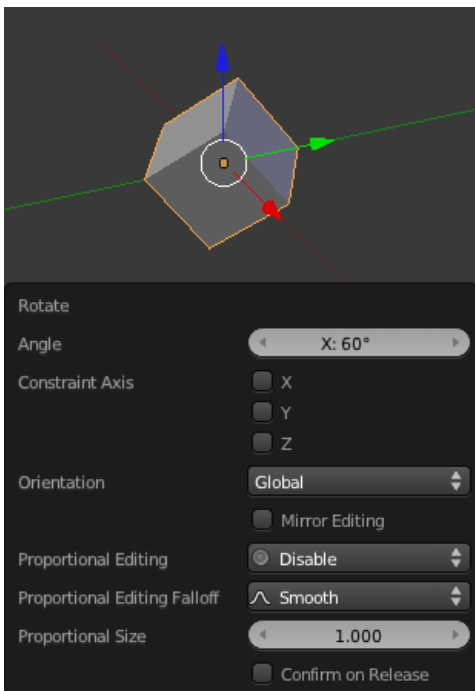
Mode: All modes

Hotkey: F6

Redo Last (New feature) is short for Redo(ing your) Last (Action). Hitting F6 after an action will present you a context-sensitive Pop-Up Window based on your last action taken and the Mode and Window in which Blender is being used.

For example, if your last action was a rotation in the Object Mode, the Window will show you the last value changed for the angle, (See Fig:Redo Last - Rotation) where you can change your action back completely typing **0** (zero) on the numeric field. There are some more useful options, based on your action context, and you can not only Undo actions, but change them completely using the available options.

If you are in the Edit Mode, the Window will also change its contents based on your last action taken. In our second example (at the right), the last action taken was a Vertex Move, we did a Scale on a Face, and, as you can see, the contents of the Pop-Up Window are different, because of your context (Edit Mode). (See Fig:Redo Last - Scale)



Redo Last - Rotation (Object Mode, 60 degrees) _____ Redo Last - Scale (Edit Mode, Resize face)



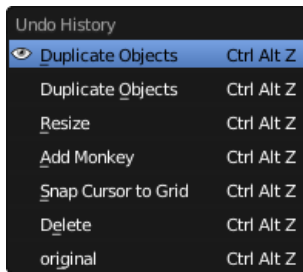
Operations using Redo Last

Some operations produce particularly useful results if you tweak their parameters with the F6 Menu. Take, for example, adding a Circle. If you reduce the Vertex count to 3, you get a perfect equilateral triangle.

Undo History

Mode: All modes

Hotkey: CtrlAltZ



The Undo History menu, which appears upon CtrlAltZ press.

There is also a Undo History of your actions, recorded by Blender. You can access the history with CtrlAltZ.

Rolling back actions using the *Undo History* feature will take you back to the action you choose. Much like how you can alternate between going backward in time with CtrlZ and then forward with ⇧ ShiftCtrlZ, you can hop around on the Undo timeline as much as you want as long as you do not make a new change. Once you do make a new change, the Undo History is truncated at that point.

Repeat Last

Mode: All modes

Hotkey: ⇧ ShiftR

The Repeat Last feature will Repeat your last action when you press ⇧ ShiftR.

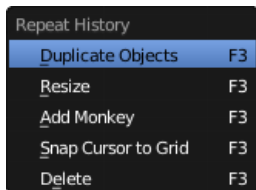
In the example Images bellow, we duplicated a *Monkey* Mesh, and then we moved the Object a bit. Using repeat ⇧ ShiftR, the *Monkey* was also duplicated and moved.



Repeat History

Mode: All modes

Hotkey: F3



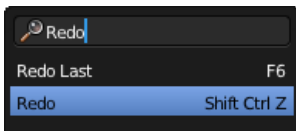
The Repeat menu, which appears upon F3 press.

The (New feature) Repeat History will present you a list of the last repeated actions, and you can choose the actions you want to repeat. It works in the same way as the Undo History, explained above, but the list contains only repeated actions. To access Repeat History, use F3.

There are two separate Histories for Blender

Blender uses two separate Histories, one dedicated for the Edit Mode, and one dedicated for the Object Mode.

Blender Search



Spacebar search for Redo
Last

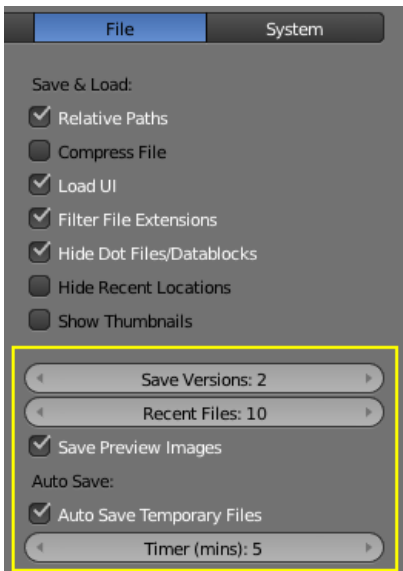
You can always access all of the explained options for user actions, using Blender Search Space.

Important Note

When you quit Blender, the complete list of the user actions will be lost, even if you save your file before quitting.

Options for Files (System Level)

Save and Auto Save



Auto Save options

Computer crashes, power outages or simply forgetting to save can result in the loss or corruption of your work. To reduce the chance of losing files when those events occur, Blender can use an Autosave function. The File tab of the User Preferences window allows you to configure the two ways that Blender provides for you to regress to a previous version of your work.

Save on Quit

The function Save on Quit is enabled by default in Blender. Blender will always save your files when you quit the application under normal operation.

Save Versions

This option tells Blender to keep the indicated number of saved versions of your file in your current working directory when you manually save a file. These files will have the extension: `.blend1`, `.blend2`, etc., with the number increasing to the number of versions you specify. Older files will be named with a higher number. e.g. With the default setting of **2**, you will have three versions of your file: `*.blend` (your last save), `*.blend1` (your second last save) and `*.blend2` (your third last save).

Auto Save Temporary Files

Checking this box tells Blender to *automatically* save a backup copy of your work-in-progress to the Temp directory (refer to the File panel in the User Preferences window for its location). This will also enable the Timer(mins) control which specifies the number of minutes between each Auto Save. The default value of the Blender installation is **5** (5 minutes). The minimum is **1**, and the Maximum is **60** (Save at every one hour). The Auto Saved files are named using a random number and have a `.blend` extension.



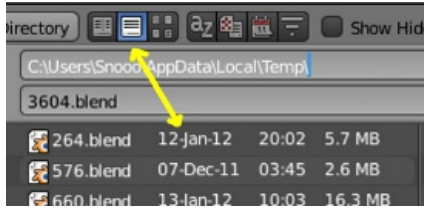
Compress Files

The option to Compress files will try to compact your files whenever Blender is saving them. Large Scenes, dense Meshes, big Textures or lots of elements in your Scene will result in a big `.blend` being created. This option could slow down Blender when you quit, or under normal operation when Blender is saving your backup files. In fact, using this option you will trade processor time for file space.

Recovering Auto Saves

Recover Last Session

File » Recover Last Session will open the `quit.blend` that is saved into the Temp directory when you exit Blender. Note that files in your Temp directory are deleted when you reboot.



Blender File Browser

- A Tip: When recovering files, you will navigate to your temporary folder. It is important, when browsing, to enable the detailed list view. Otherwise, you will not be able to figure out the dates of the auto-saved .blends. (See Figure: Blender File Browser)

Recover Auto Save

File » Recover Auto Save... allows you to open the Auto Saved file. After loading the Auto Saved version, you may save it over the current file in your working directory as a normal `.blend` file.

Important Note

When recovering an Auto Saved file, you will lose any changes made since the last Auto Save was performed.

Only **one** Auto Saved file exists for each project (i.e. Blender does not keep older versions – hence you won't be able to go back more than a few minutes with this tool).

Other options

Recent Files

This setting controls how many recent files are listed in the File » Open Recent sub-menu.

Save Preview Images

Previews of images and materials in the File Browser window are created on demand. To save these previews into your `.blend` file, enable this option (at the cost of increasing the size of your `.blend` file).

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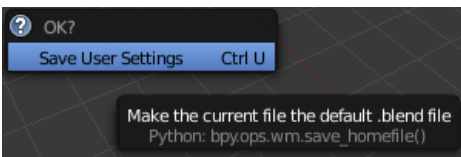
Setting the default Scene

Mode: All modes

Hotkey: CtrlU

Menu: File » Save User Settings

When you start Blender or start a new project with the menu entry File » New or using the shortcut CtrlN, a new Scene is created from the default Scene stored in the User Preferences.





Save User Settings popup

To change the default scene, make all of the desired changes to the current scene and press CtrlU.

The Save User Settings popup confirmation will appear. Click LMB  on the Save User Settings popup or press ↵ Enter.

Press Esc to abort.

From the menu

To change the default Scene from the menu, make all of the desired changes to the current Scene you are working on and LMB  in File » User Preferences. The User Preferences Editor Window will appear. In the Interface Tab, click LMB  on the Save As Default button to save the changes. The current scene, all objects, and settings will then be saved in the User Preferences as your starting Scene. (See Fig: Image of the User Preferences Window, with *Save as Default* highlighted in yellow).

If you don't want to use your Scene and/or Blender customization as your default Scene, leave the User Preferences Editor Window without clicking the Save As Default button, and your default Scene when starting Blender will remain unchanged.

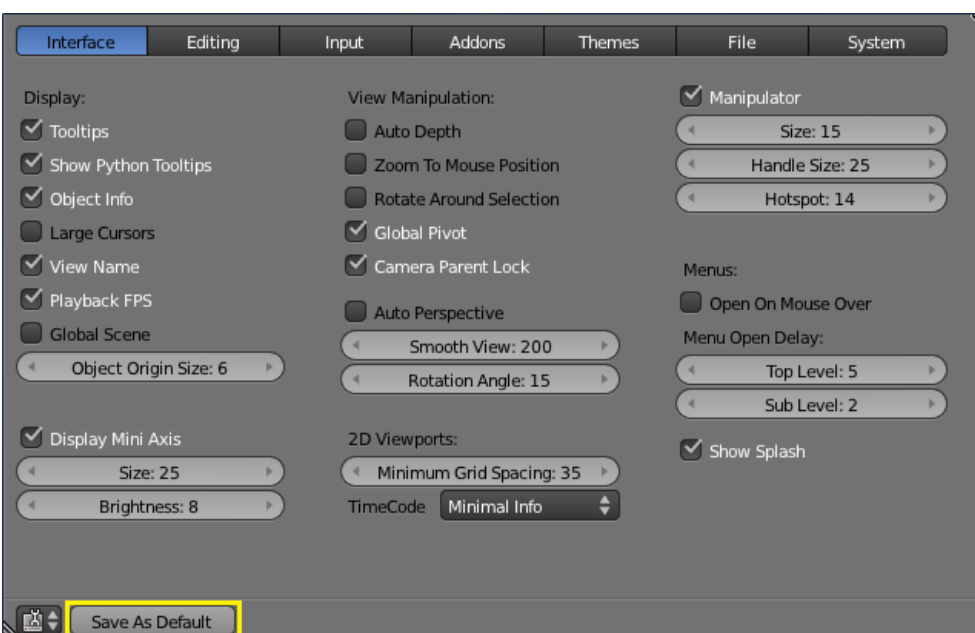



Image of the User Preferences Window, with *Save as Default* highlighted in yellow

Restoring the Default Scene to Factory Settings

Mode: All modes

Hotkey: Undefined, you can add one for your [Keymap »](#)

Menu: File » Load factory Settings

To restore the default scene to the factory settings, LMB  in File » Load Factory Settings. This will restore all User Preferences back to the original Factory Settings. To save the changes, use CtrlU and your Factory Settings will be saved as the default Scene for Blender.

User Preferences Window

For more information about the Editor Window for User Preferences or how to clean your preferences manually, please read the chapter about [User Preferences](#)

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Screenshots and Screencasts

In order to facilitate teamwork and rapid prototyping, you may want to quickly take pictures or make videos of your work. In this chapter, we explain the options present in Blender, and at the end of the page, we offer some useful shortcuts to take screenshots in the most used Operating Systems and some Software options.

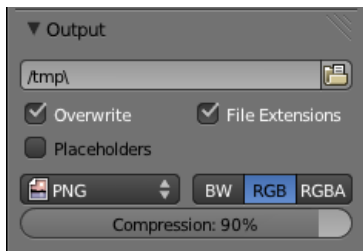
In Blender you have the following options:

- Blender Screenshots: very useful to show what's going on with your work or to ask for help, show stages of modeling, or highlight necessary details of your work.
- Blender Screencasts: useful for teaching, creating timelapses of your work, or even test videos, showing manually created movements over time.

Blender Screenshots

Mode: All modes

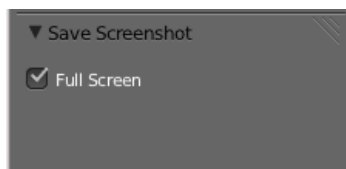
Hotkey: CtrlF3



Output Panel PNG Image format

The shortcut CtrlF3 will take a screenshot of your Blender window and then open the Blender File Browser Window, allowing you to specify the name and location of the screenshot. In the example Image at the right, the PNG format will be the output of the Screenshot taken. The picture taken will be saved in the format specified in the [Output panel](#) of the [Render context](#) Window (See fig: Output Panel PNG Image format).

- Blender Screenshots are saved with the full width and height of the Blender window you are using when you call the command.



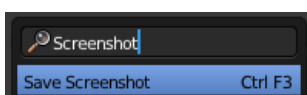
Save Screenshot Option

There is also an option to save only the active Window you are working in. When the Blender File Browser window opens for you, at the left, there is a Tab called *Save Screenshot* where you can find a Checkbox with the Option *Full Screen* (See Fig: Save Screenshot Option).

- Check the Option to save the entire Blender Window.
- Uncheck the box to save only your active Window (where your Mouse is located when you call the command).



Keyboard Shortcut Conflicts



Search Functionality

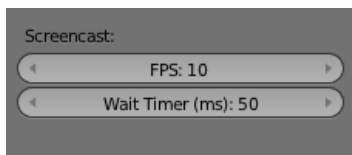
Sometimes, the operating System you are using is designed to use some Shortcuts that the default Blender installation also uses for its functions. In this case, you can use the search functionality present in Blender. (See Fig: Search Functionality). Hit Space and type Screenshot, in the Search Popup

Blender Screencasts

Mode: All modes

Hotkey: AltF3

The shortcut AltF3 starts the screencast function. Screencasts will record your actions over time either as a video or sequence of image files. The type and location of the output is determined by the settings in the [Output panel](#) of the [Render context](#) window. The default settings will generate a screencast consisting of a series of PNG images captured every 50 ms and stored in the /tmp folder. If you want to record a video, set the Output to one of the Movie File Formats supported by your system listed in the Output panel format menu. If you are unsure what video codecs your system supports, select AVI JPEG.



Options in the User Preferences Editor

The FPS for video Screencasts and time between each Screenshot for an image series Screencast can be set from the [System panel](#) of the [User Preferences](#) window.

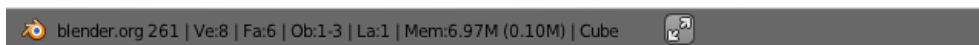
(See Fig: Options in the User Preferences Editor)

Audio support

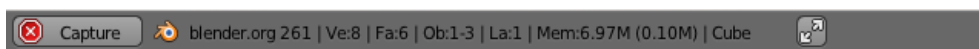
Blender Screencast doesn't support audio recordings, so you will have to do it manually using other software, e.g. [Audacity](#), in conjunction with Blender.

When you start Blender Screencasts, the header of the Info Window will change, and it will show you a button for stopping your capture.

Bellow, we show the normal header of the Info Window, when in normal Blender operation (See Fig: Info Window - Header - Normal Operation), and with the Stop button for the Screencast, when in Screencast Mode. (See Fig: Info Window - Header - Capture Stop Button).



Info Window - Header - Normal Operation

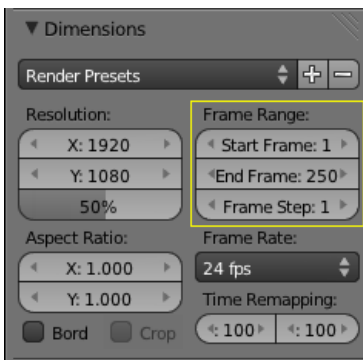


Info Window - Header - Capture Stop Button

(Note: The header Image was taken using Blender 2.61)

The only way to stop the Screencast

Pressing the Stop button in the header of the Info Window is the only way to stop the Screencast capture. If you press Esc, the shortcut will only work for operations performed in the Blender User Interface, (it will stop animations, playbacks and so on...), but will not work to stop Screencasts.



Dimensions Panel - Frame Range

The frames are stored using a suffix added to their file name, where the suffix is composed of the numbers present in the fields for *start* and *end frames*, defined in the Frame Range of the Dimensions panel, [Render context](#). (See Fig: Dimensions Panel - Frame Range - highlighted in yellow)



Important:

The configuration of the End frame, present in the Frame Range of the Dimensions Panel, **will not** stop your capture automatically. You will always have to stop the Screencast manually, using the Stop button.

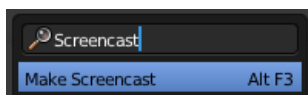
The Videos are generated internally in the same manner as the Screenshots, using the width and height of the Window you are working in. If you choose to capture to a Video file, Blender will have to pass those frames to a Video codec.

Warning: Some codecs limit the output width/height or the video quality.

- When you save your Screencast in an Image format, the Images will be saved using the entire Blender Window, with full width and height, and the quality of the Image will be defined by its type (i.e. JPG, PNG, and so on) and configuration (i.e. Slider *quality* of the .JPG format).
- When you save your Screencast in a Video format, it will be sent to a codec. Depending on the codec limitations, the resulting output Video could be scaled down. Furthermore, some combinations of Window width and height cannot be processed by certain codecs. In these cases, the Screencast will try to start, but will immediately stop. In order to solve this, choose another Window format and/or another codec.



Keyboard Shortcut Conflicts



Search Functionality

Sometimes, the Operating System you are using is designed to use some Shortcuts that the default Blender installation also uses for its functions. In this case, you can use the search functionality present in Blender. (See Fig: Search Functionality). Hit Space and type Screenshot, in the search Popup.

Blender Window Dimension

There is a way to match the Blender Window dimensions with the Output Video File, achieving standard dimensions for the output of the Blender Screencast. (i.e. NTSC, HD, Full HD, etc). You can control the width and height of your Blender Window, starting Blender from a Command Line. To learn more about starting Blender from a command line, see the page about [Blender Console Window](#).

Addon: 3D View:Screencast Keys

The community based Addon 3D View:Screencast Keys will show you the keys, combination of keys pressed and mouse clicks on the left bottom corner of your 3D screen every time you press a key or mouse button when capturing Screencasts. The community Addon comes with the default installation of Blender. The Image below shows the community Addon with its Tab Open. (See Fig: 3D View: Screencast Keys - Addon). To enable the Addon, open the User Preferences Editor Window CtrlAltU, go to the Addons Tab, and go to the 3D ViewAddons. Just click on the checkbox (Highlighted in yellow) to enable the Addon.

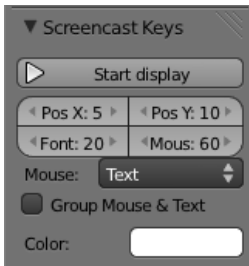


3D View: Screencast Keys - Addon

Mode: All modes → Addon Enabled

Hotkey: Use N to show the Properties Panel → Screencast Keys Tab

Menu: View » Properties → Screencast Keys Tab



Screencast Keys
Addon Tab - Properties
Panel

Once the Addon is enabled you will see the Screencast Keys section at the end of the list, on the Properties panel.

Description:

- **Start display button:** When you press this button, Blender will display any Key or combination of Keys you are pressing on the bottom left corner of the 3D window as floating text. If you press several times the same Key or combination of Keys, Blender will add an "xn" tag at the end of the Keys or combination of Keys, indicating how many times you pressed the Key or combination of Keys.
- **Stop display button:** will stop Blender from displaying ScreenCast Keys.
- **PosX:** position of the Screencast text on **X** axis.
- **PosY:** position of the Screencast text on **Y** axis.
- **Font:** Screencast text font size.
- **Mouse:** Screencast mouse icon size.
- **Mouse display:** In this drop down menu you can select how the Screencast text will be displayed
- **Text:** Will display the Keys pressed and Mouse buttons pressed as text.
- **Icon:** Will display the Mouse as an icon and Keys pressed as text.
- **None:** Will display info about Keys pressed only, without mouse button info.
- **Group Mouse & Text Check box:** When this is checked, Blender will display a box around the Screencast Text to make reading easy.
- **Color:** Lets you choose the color of the Screencast text.



New Community Addon

There is also currently an Addon for Blender 2.5/2.6 which will take a screenshot of any area you like at the click of a button, and proceed to upload it directly to [Pasteall](#). The Addon currently has no development page, but it will be linked to here when it's finished.



Operating System Screenshots

You may also use the Operating system to capture the screen to the clipboard. You can then paste the image from the clipboard into your image editor.

Windows Screenshots



Press Alt+Print screen to capture the active program window to the clipboard.

Mac OSX Screenshots

Press  Cmd  Shift3 to capture the screen to a file on the desktop.

Press Ctrl Cmd  Shift3 to capture the screen to the clipboard.

Press  Cmd  Shift4 to capture an area of the screen to a file on the desktop.

Press Ctrl Cmd  Shift4 to capture an area of the screen to the clipboard.

GNU/Linux Screenshots

On some Linux distributions (such as Ubuntu) and window managers, you can press Print screen to capture the screen to a file. For other distributions or window managers you may require additional software. Examples of such software include, but are not limited to: [xvidcap](#), [scrot](#) and [recordMyDesktop](#). Consult your distribution's manual or software repository for more information.

Software Screenshots

In addition to the options present in Blender and in your Operating System, there is other useful software to take Screenshots of your screen, like Gimp, Photoshop, Screenhunter, and so on.

Gimp Screenshots

Taking Screenshots from Gimp:

- Go to File -> Create -> Screenshot.
- There are two options:
 - Take a Screenshot of a single Window
 - Take a Screenshot of the entire Screen

There is also a Delay field, where you can input some delay in seconds. Choose the appropriate options and click on the *Snap* Button. If you choose to Take a Screenshot of a single Window, you will have to click in a Window at the end of the delay.

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Help system

Mode: All modes

Hotkey: Undefined - You can add one for your [Keymap »](#)

Menu: Help

Blender has a range of built-in and web-based Help options.

The built in help options include:

- A Menu with all of the Help Options including the Web based ones. Some of them are also present in the Splash Screen.

Other new features like:

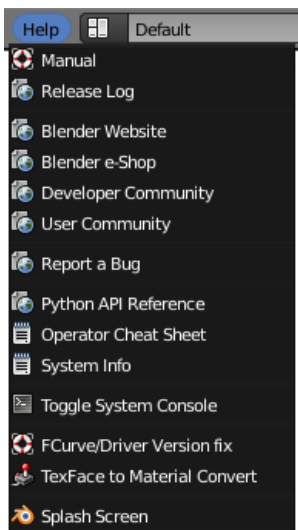
- The Blender Search (new feature).
- Tooltips showing also the internal Python Operators (new feature), when the user hovers the Mouse over a Button, a Menu, Numeric Field or any Blender function that has a named Python Operator.

General Web-based Help Options



Browser and Internet Connection

Some forms of Help start up your web browser and access the Blender Foundation's web servers. In order to do this, you must have configured a default web browser for your Operating System, and have a connection to the Internet.



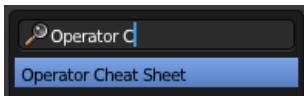
Help menu

- [Manual](#) - This is a link for the Official Blender Manual, in *Wiki* format, which you are now reading.
- [Release Log](#) - The release notes on the Web for the current Blender version.
- [Blender Website](#) - The blender.org home page.
- [Blender e-Shop](#) - The Blender e-Store, where you can buy Training DVD's, books, t-shirts and other products.
- [Developer Community](#) - The blender.org "Get Involved" page. This is the launch page for Blender software development, bug tracking, patches and scripts, education and training, documentation development and functionality research.
- [User Community](#) - Lists of many different support venues here.
- [Report a Bug](#) - The Blender Bug Tracker page.

Important: in order to Report a Bug, you must register at the website.

Programming Options

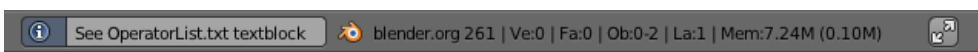
- [Python 2.6X API Reference](#) - Python application programming interface (API) that Blender and [Python](#) use to communicate with each other. Useful for the Blender Game Engine, Customising, and other scripting.



Operator Cheat Sheet

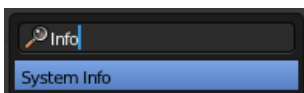
- Operator Cheat Sheet - Creates the `operatorList.txt` file, which you can access in the Text Editor. You can also use Blender Search to generate the file. The text will list the available Python operators. At the time we were writing this part of the Manual (Blender 2.61), Blender had 1245 Operators.

While Blender is generating this list, the Info Window will change, showing a message for the operation (See Fig: Info Window – Operator Cheat Sheet). To read the Text, switch to the Blender Text Editor Window, using the [Window type Selector](#), and then, clicking on the button *Browse Text to be Linked* of the Text Editor, your text block will be shown in the Editor. The file will be in your list of Text files, named as *OperatorsList.txt*, if the file is already generated, Blender will add a numeric suffix for the subsequent ones.



Info Window – Operator Cheat Sheet

Diagnostics Options



Blender Search - System

Info

- System Info - Creates a `system-info` file, which you can access in the Blender Text Editor. The text lists various key properties of your system and Blender, which can be useful in diagnosing problems. When you click on this Option, Blender will verify your installation, will change the Info Window for a while when generating the file (See: Info Window – Info.txt). You can also use Blender Search to generate the file.

To read the Text, switch to the Blender Text Editor Window, using the [Window type Selector](#), and then, clicking on the button *Browse Text to be Linked* of the Text Editor, your text block will be shown in the Editor. The file will be in your list of Text files, named as *system-info.txt*, if the file is already generated, Blender will add a numeric suffix for the subsequent ones.

- The text file is created with **4** different sections: Blender, Python, Directories and OpenGL, which we will explain below:
 - **Blender:** This section of the info.txt shows you the Blender version, flags used when Blender was compiled, day and time when Blender was compiled, build system, and the path in which Blender is running.
 - **Python:** The Python version you are using, showing the paths of the Python programming language paths.
 - **Directories:** The Blender directories setup for `scripts`, `user scripts`, `datafiles`, `config`, `scripts (internal)`, `autosave` directory and `temp dir`. Those directories are configured using the [User Preferences](#) Editor Window.
 - **OpenGL:** This section will show you the version of OpenGL that you are using for Blender, the name of the manufacturer, version, vendor and a list with your card capabilities or OpenGL software capabilities.



Info Window – Info.txt

- Toggle System Console - Reveals the command window that contains Blender's stdout messages. Can be very useful for figuring out how the UI works, or what is going wrong if you encounter a problem. Even more information is available here, if you invoke Blender as `blender -d`. This menu item only shows up on Windows.
 - In all Operating Systems, to see this information, simply run `blender` from the command-line.
 - On Linux, if you ran Blender from the GUI, you can see the output in `~/.xsession-errors`
 - On Mac OS X, you can open `Console.app` (in the Utilities folder in Applications) and check the Log there.
- Info Window Log - This is not exactly a Help menu, but it is related. If you mouseover the line between the Info window and the 3D then click and drag the Info window down a bit, you can see the stream of Python calls that the UI is making when you work. This can be useful in creating scripts.

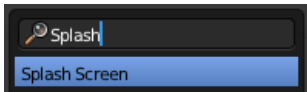
```
bpy.ops.mesh.primitive_cube_add(view_align=False, enter_editmode=False, location=(-7.8
0761, -5.16298, 10.1537), rotation=(0, 0, 0), layers=(True, False, False, False, False
, False, False, False, False, False, False, False, False, False, False, False, False,
False, False, False))
```

The Info Window Log after adding a Cube

Legacy Version Support

- FCurve/Driver fix - Sometimes, when you load .blend's made from older versions of Blender (2.56 and previous), the Function Curves and Shapekey Drivers will not function correctly due to updates in the animation system. Selecting this option updates the FCurve/Driver data paths.
- TexFace to Material Convert - Convert old Texface settings into material. It may create new materials if needed.

Splash Screen



Splash Screen Search

Splash Screen - This displays the image where you can identify package and version. At the top-right corner, you can see the Version and SVN (Subversion) revision (See Fig: Blender Splash Screen). For example, in our Splash Screen, you can see the version **2.61.0** and the revision number **r42615** highlighted in green. This can be useful to give to support personnel when diagnosing a problem. You can also use Blender Search to Show the Splash Screen or click in the Small Blender Logo present in the Info Window

There are some Internet Based Help options that are also present in the Blender Splash Screen, those options are highlighted in Yellow in the image.



Blender Splash Screen, Blender Version 2.61

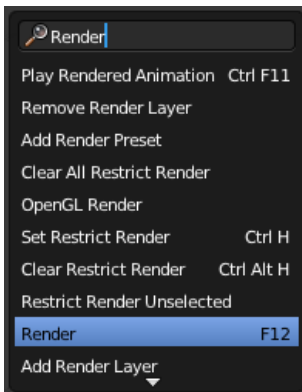
Other Help Options

Here we explain the two new features added for Blender, Blender Search and the recoded Tooltips.

Blender Search

Mode: All modes

Hotkey: Space



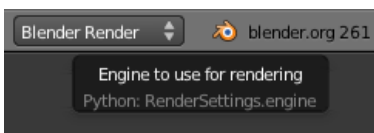
Blender Search - Render

The Blender Search feature, called Blender Search, is a new functionality added by the Blender recode (from 2.4x series to 2.5x series and so on). The Internal name of the feature is *Operator Search*. When you hit Space from your keyboard, Blender will present you with a small Pop Up Window, no matter which Blender Window your Mouse pointer is located (except the Text Editor Window and Python console), and a field for you to type in. Just type what you need and Blender will present you a list of available options. You can click on the appropriate function for you, or search through them using your keyboard, type `↵` Enter to accept, or Esc to leave. Clicking outside of the Blender Search Window or taking the Mouse pointer away, will also leave Blender Search.

The Image at the right shows Blender Search when we type the word *Render* inside the field. If you continue typing, your search keywords will refine your search and if no named operator can be found, the small Pop Up Window for the Blender Search will stay blank.

- How it works:
 - Every Blender Internal Operator can use a defined name, some of them are predefined names for the user. For example, the Render command is a named Python call, the appropriate Operator is `Python: bpy.ops.render.render()`, but for the user, it is called Render. All of those *user* names that were previously attributed for Python operators can searched for using Blender Search.

Tooltips



The Mouse pointer was Stopped for a while over the Render Engines List in the Info Window. The normal Tooltip is in white and the Python operator is displayed in grey

The Tooltips in Blender were completely recoded, and every time you hover your Mouse over a Button, a Command, Numeric Fields or things that are related to Operators, staying for a while, it will show you not only the normal Tooltip, but also the specific related operator. Those operators are useful for lots of tasks, from Python Scripts to Keymaps. In the example Image at the right, we pointed our Mouse over the Info Window, specifically over the list of the Render engines available, waited for a while, and the Tooltip with the appropriate operator was shown. In our example, it shows the Tooltip *Engine to Use for Rendering* in white, and `Python: RenderSettings.engine` in grey, which is the Operator associated with the function.

This chapter explains how to change Blender's default configuration with the User Preferences editor.

The Blender User Preferences editor contains many of the settings that you can change to control the way Blender behaves each time you open the application.

Open User Preferences

To open a Blender User Preferences editor go to File » User Preferences or press CtrlAltU. Mac users can press ⌘ Cmd,. You can also load the Preferences editor in any window by selecting  User Preferences from the Window type selection menu.



This editor permits you to configure how Blender will work. The available options are grouped into seven tabs, accessible at the top of the window. The options are: *Interface*, *Editing*, *Input*, *Add-Ons*, *Themes*, *File* and *System*.

Configure

Now that you have opened the User Preferences editor, you can configure Blender to your liking. Select what you want to change in the following list:

[Interface](#) • [Editing](#) • [Input](#) • [Add-Ons](#) • [Themes](#) • [File](#) • [System](#)

Save the new preferences

Once you have set your preferences, you will need to manually save them otherwise the new configuration will be lost after a restart or when starting a new scene. Blender saves its preferences with each scene which can be convenient when you need a certain layout or special addons.

On the header (in this case a footer) of the User Preferences window, click on Save As Default. This will save:

- All of the new preferences.
- The currently open scene as the default scene.

You can also save the User Preferences at any time by pressing CtrlU.

Load Factory Settings

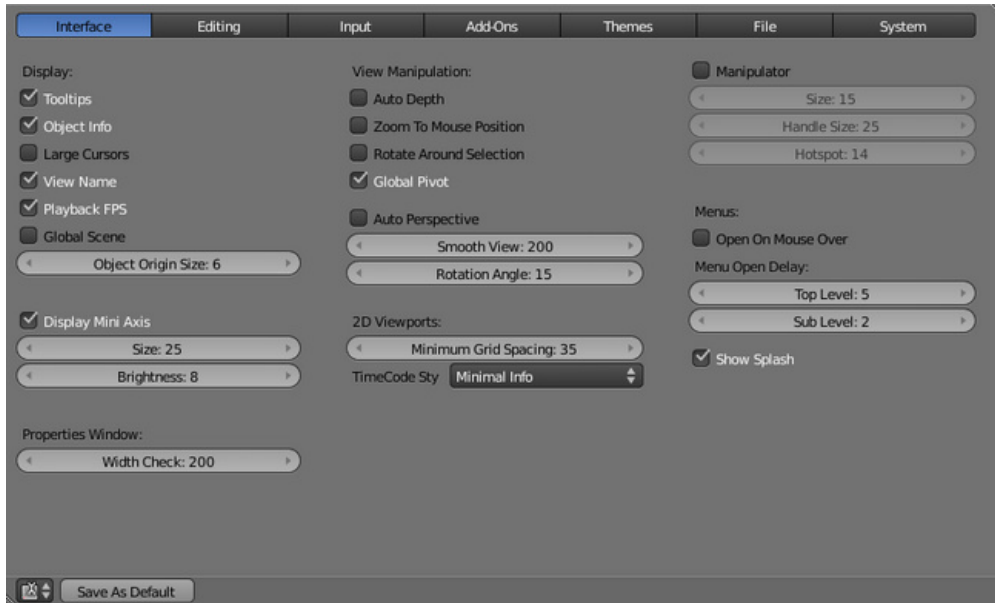
There are two ways to restore the default Blender settings:

1. Go to File » Load Factory Settings and then save the preferences with CtrlU or via the User Preferences editor.
2. Delete the `startup.blend` file from the following location on your computer:
 - Linux: `/home/$user/.blender/'Version Number'/config/startup.blend` (you'll need to show hidden files).
 - Windows 7 and Windows Vista: `C:\Users\$user\AppData\Roaming\Blender Foundation\Blender\'Version Number'\config\startup.blend`
 - MacOS: `/Users/$user/Library/Application Support/Blender/'Version Number'/config/startup.blend` (you'll need to show hidden files).

While you're in the Blender config folder, it can be valuable to copy your Blender settings file to another

folder. In the event that you lose your configuration, you can restore your Blender settings file with your backup copy.

Interface configuration lets you change how UI elements are displayed and how they react.



Display

Tooltips

When enabled, a tooltip will appear when your mouse pointer is over a control. This tip explains the function of what's under the pointer, gives the associated hotkey (if any) and the Python function that refers to it.

Object Info

Display the active Object name and frame number at the bottom left of the 3D view.

Large Cursors

Use large mouse cursors when available.

View Name

Display the name and type of the current view in the top left corner of the 3D window. For example: User Persp or Top Ortho.

Playback FPS

Show the frames per second screen refresh rate while an animation is played back. It appears in one of the viewport corners.

Global Scene

Forces the current scene to be displayed in all other scenes (a project can consist of more than one scene).

Object Origin Size

Diameter of 3D Object centers in the view port (value in pixels from 4 to 10).

Display Mini Axis

Show the mini axis at the bottom left of the viewport.

Size

Size of the mini axis.

Brightness

Adjust brightness of the mini axis.

Properties Window

Width Check

When the Properties window has a width below this value, it will display its buttons in one column rather than two.

View manipulation

Auto Depth

Use the depth under the mouse to improve view pan/rotate/zoom functionality.

Zoom to Mouse Position

When enabled, the mouse pointer position becomes the focus point of zooming instead of the 2D window center. Helpful to avoid panning if you are frequently zooming in and out.

Rotate Around Selection

The selected object becomes the rotation center of the viewport.

Global Pivot

Lock the same rotation/scaling pivot in all 3D views.

Auto Perspective

Automatically to perspective Top/Side/Front view after using User Orthographic. When disabled, Top/Side/Front views will retain Orthographic or Perspective view (whichever was active at the time of switching to that view).

Smooth View

Length of time the animation takes when changing the view with the numpad (Top/Side/Front/Camera...). Reduce to zero to remove the animation.

Rotation Angle

Rotation step size in degrees, when 4 NumPad, 6 NumPad, 8 NumPad, or 2 NumPad are used to rotate the 3D view.

2D Viewports

Minimum Grid Spacing

The minimum number of pixels between grid lines in a 2D (i.e. top orthographic) viewport.

TimeCode Style

Format of Time Codes displayed when not displaying timing in terms of frames. The format uses '+' as separator for sub-second frame numbers, with left and right truncation of the timecode as necessary.

Manipulator

Permits configuration of the 3D transform manipulator which is used to drag, rotate and resize objects (Size, Handle size).

Menus

Open on Mouse Over

Select this to have the menu open by placing the mouse pointer over the entry instead of clicking on it.

Menu Open Delay

Top Level

Time delay in 1/10 second before a menu opens (Open on Mouse Over needs to be enabled).

Sub Level

Same as above for sub menus (for example: File » Open Recent).

These preferences control how several tools will interact with your input.

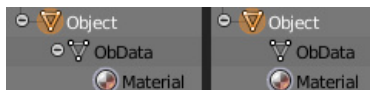


Link Materials To



To understand this option properly, you need to understand how Blender works with Objects. Almost everything in Blender is organized in a hierarchy of Datablocks. A Datablock can be thought of as containers for certain pieces of information. For example, the Object Datablock contains information about the Object's location while the Object Data (ObData) datablock contains information about the mesh.

A material may be linked in two different ways:



A material linked to ObData (left) and Object (right).

ObData

Any created material will be created as part of the ObData datablock.

Object

Any created material will be created as part of the Object datablock.

[Read more about Blender's Data System »](#)

New objects

Enter Edit Mode

If selected, Edit Mode is automatically activated when you create a new object.

Align To

World

New objects align with world coordinates.

View

New object align with view coordinates.

Undo

Global Undo

Works by keeping a full copy of the file in memory (thus needing more memory).

Step

Number of Undo steps available.

Memory Limit

Maximum memory usage in Mb (0 is unlimited).

[Read more about Undo and Redo options »](#)

Grease Pencil

Grease Pencil permits you to draw in the 3D viewport with a pencil-like tool.

Manhattan Distance

The minimum number of pixels the mouse has to move horizontally or vertically before the movement is recorded.

Euclidian Distance

The minimum distance that mouse has to travel before movement is recorded.

Eraser Radius

The size of the eraser used with the grease pencil.

Smooth Stroke

Smooths the pencil stroke after it's finished.

Playback

Allow Negative Frame

If set, negative framenumbers might be used.

Keyframing

In many situations, animation is controlled by keyframes. The state of a value (i.e. location) is recorded in a keyframe and the animation between two keyframes is interpolated by Blender.

Visual Keying

Use Visual keying automatically for constrained objects.

Only Insert Needed

When enabled, new keyframes will be created only when needed.

Auto Keyframing

Automatic keyframe insertion for Objects and Bones. Auto Keyframe is not enabled by default.

Only Insert Available

Automatic keyframe insertion in available curves.

New F-Curve Defaults

Interpolation




This controls how the state between two keyframes is computed. Default interpolation for new keyframes is Bezier which provides smooth acceleration and de-acceleration whereas Linear or Constant is more abrupt.

XYZ to RGB

Color for X, Y or Z animation curves (location, scale or rotation) are the same as the colour for the X, Y and Z axis.

Transform

Release confirm

Dragging LMB  on an object will move it. To confirm this (and other) transforms, a LMB  is necessary by default. When this option is activated, the release of LMB  acts as confirmation of the transform.

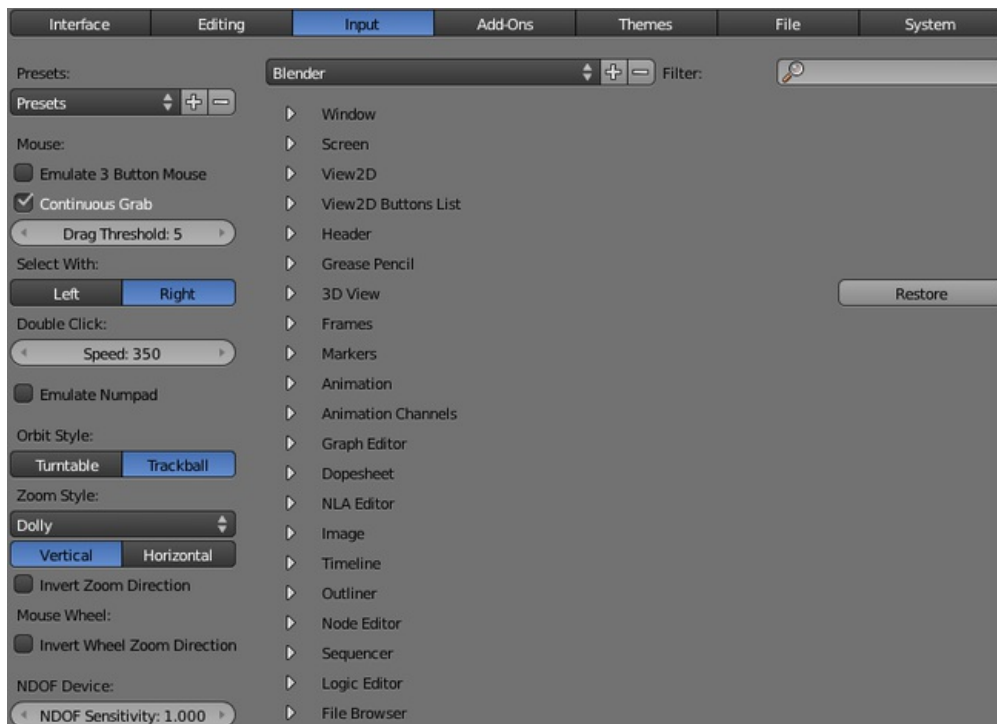
Duplicate Data

The 'Duplicate Data' check-boxes define what data is copied with a duplicated Object and what data remains linked. Any boxes that are checked will have their data copied along with the duplication of the Object. Any boxes that are not checked will instead have their data linked from the source Object that was duplicated.

For example, if you have Mesh checked, then a full copy of the mesh data is created with the new Object, and each mesh will behave independently of the duplicate. If you leave the mesh box unchecked then when you change the mesh of one object, the change will be mirrored in the duplicate Object.

The same rules apply to each of the check-boxes in the 'Duplicate Data' list.

In the Input preferences, you can customize how Blender reacts to the mouse and keyboard as well as define your own keymap.



Managing presets

Blender lets you define multiple Preset input configurations. Instead of deleting the default keymap to create yours, you can just add new Presets for both the mouse and keyboard. Mouse options can be found on the left hand side of the window and keyboard options to the right in the above picture.

Adding and deleting presets



Before changing anything in the default configuration, click on the "plus" symbol shown in the picture to add a new Preset. Blender will ask you to name your new preset after which you can select the Preset from the list to edit it. If you want to delete your Preset, select it from the list and then click the "minus" symbol.

Selecting presets

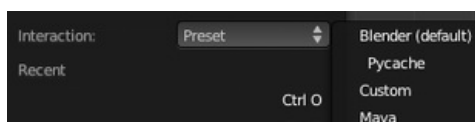
You can change the preset you are using by doing one of the following:

- Selecting the configuration from the Interaction menu of the splash screen at startup or by selecting Help » Splash Screen.
- Selecting the configuration from the User Preferences Input window.

Note

Note that either of the above options will only change the preset for the current file. If you select File » New or File » Open, the default preset will be re-loaded.

Setting presets to default




Once you've configured your mouse and keyboard Presets, you can make this the default configuration by:

- Opening the User Preferences Input editor and select your presets from the preset list or,

- Selecting your preset configuration from the splash screen.
- Saving your configuration using the Save As Default option from a User Preferences window or by pressing CtrlU.

Export/Import key configuration

In some cases, you may need to save your configuration in an external file (e.g. if you need to install a new system or share your keymap configuration with the community). Simply LMB  Export Key Configuration on the Input tab header and a file browser will open so that you can choose where to store the configuration. The Import Key Configuration button installs a keymap configuration that is on your computer but not in Blender.

Mouse

Emulate 3 Button Mouse

It is possible to use Blender without a 3 button mouse (such as a two-button mouse, Apple single-button Mouse, or laptop). This functionality can be emulated with key/mousebutton combos. This option is only available if Select With is set to Right.

[Read more about emulating a 3 button mouse »](#)

Continuous Grab

Allows moving the mouse outside of the view (for translation, rotation, scale for example).

Drag Threshold

The number of pixels that a User Interface element has to be moved before it is recognized by Blender.

Select with

You can choose which button is used for selection (the other one is used to place the 3D cursor).

Double Click

The time for a double click (in ms).

Note


If you're using a graphic tablet instead of mouse, and pressure doesn't work properly, try to place the mouse pointer to Blender window and then unplug/replug your graphic tablet. This might help.

Numpad emulation

The Numpad keys are used quite often in Blender and are not the same keys as the regular number keys. If you have a keyboard without a Numpad (e.g. on a laptop), you can tell Blender to treat the standard number keys as Numpad keys. Just check Emulate Numpad.

View manipulation



Orbit Style

Select how Blender works when you rotate the 3D view (by default MMB ). Two styles are available. If you come from Maya or Cinema 4D, you will prefer Turntable.


Zoom Style

Choose your preferred style of zooming in and out with Ctrl MMB .

Scale

Scale zooming depends on where you first click in the view. To zoom out, hold Ctrl MMB  while dragging from the edge of the screen towards the center. To zoom in, hold Ctrl MMB  while dragging from the center of the screen towards the edge.

Continue

The Continue zooming option allows you to control the speed (and not the value) of zooming by moving away from the initial click-point with Ctrl MMB . Moving up from the initial click-point or to the right will zoom out, moving down or to the left will zoom in. The further away you move, the faster the zoom movement will be. The directions can be altered by the Vertical and Horizontal radio buttons and the Invert Zoom Direction option.

Dolly

Dolly zooming works similarly to Continue zooming except that zoom speed is constant.

Vertical

Moving up zooms out and moving down zooms in.

Horizontal

Moving left zooms in and moving right zooms out.

Invert Zoom Direction

Inverts the Zoom direction for Dolly and Continue zooming.

Invert Wheel Zoom Direction

Inverts the direction of the mouse wheel zoom.

NDOF device

Set the sensitivity of a 3D mouse.

Keymap editor



The Keymap editor lets you change the default Hotkeys. You can change keymaps for each window.

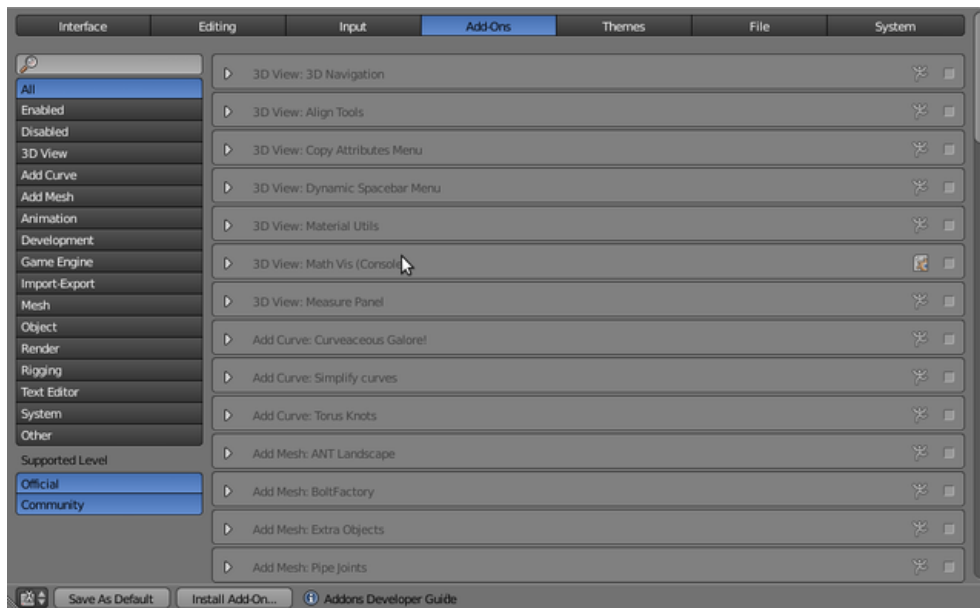
1. Select the keymap you want to change and click on the white arrows to open up the keymap tree.
2. Select which Input will control the function
 - Keyboard: Only hotkey or combo hotkey (E or ⇧ ShiftE).
 - Mouse: Left/middle/right click. Can be combined with Alt, ⇧ Shift, Ctrl, ⌘ Cmd.
 - Tweak: Click and drag. Can also be combined with the 4 previous keys.
 - Text input: Use this function by entering a text
 - Timer: Used to control actions based on a time period. e.g. By default, Animation Step uses Timer 0, Smooth view uses Timer 1.
3. Change hotkeys as you want. Just click on the shortcut input and enter the new shortcut.

If you want to restore the default settings for a keymap, just click on the Restore button at the top right of this keymap.

[Interface](#) • [Editing](#) • [Input](#) • **Add-Ons** • [Themes](#) • [File](#) • [System](#)

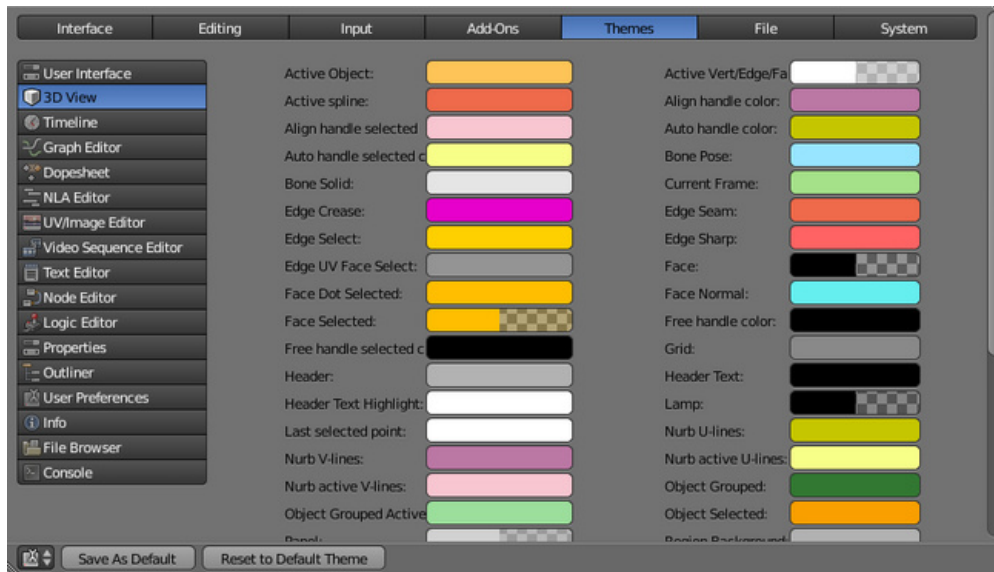
The Add-Ons tab lets you manage secondary options which are not enabled in Blender by default. New features may be added with *Install Add-Ons*. There will be a growing number of such Add-Ons, generated by the Blender-community so look out for that one feature you were missing (or maybe simply create it yourself).

See the [Add-Ons Page](#) for more on using Add-Ons.



Customizing themes

As has been said previously, Blender is very customizable—some of the settings affect interface appearance and colors. These are set under the Themes tab.

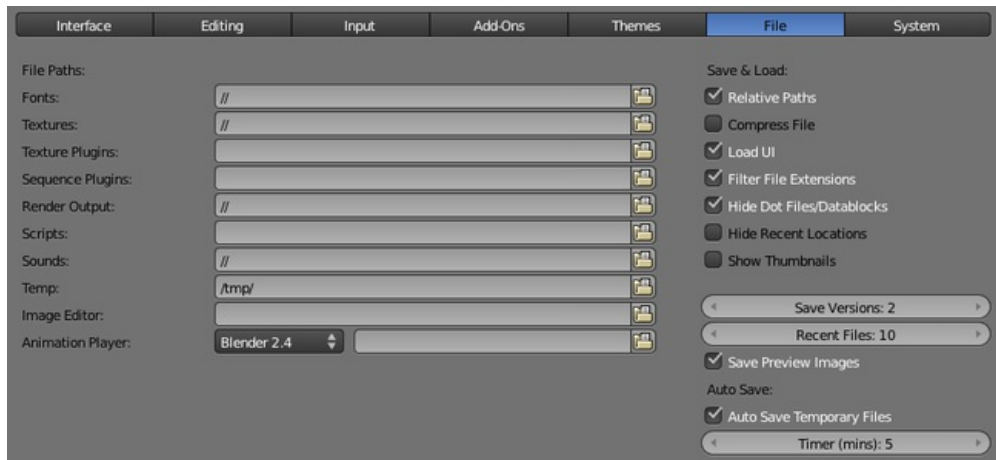


The colors for each editor can be set separately—simply select the editor you wish to change in the multi-choice list at the left, and adjust colors as required. Notice that changes appear in real-time on your screen. In addition, details such as the dot size in the 3D View or the Graph Editor can also be changed.

Themes use blenders preset system, you can save a theme to an XML and install it on another system.

File Preferences

The picture shows the file preferences which are explained below.



File Paths

When you work on an important project, it is wise to configure it. Set default paths for the different file types you will be using.

Here is an example of a configuration:

Fonts	//fonts/
Textures	//textures/
Texture Plugins	//plugins/texture/
Sequence Plugins	//plugins/sequence/
Render Output	//renders/
Scripts	//scripts/
Sounds	//sounds/
Temp	//tmp/

Note that blender wont create your project structure automatically. You need to create all directories manually in your file browser.

Scripts Path

By default Blender looks in several directories (OS dependant) for scripts. By setting a user script path in the preferences an additional directory is looked in. This can be used to store certain scripts/templates/presets independently of the currently used Blender Version.

Inside the specified folder specific folders have to be created to tell Blender what to look for where. This folder structure has to mirror the structure of the scripts folder found in the installation directory of Blender:

```
- scripts
- addons
- modules
- presets
  - camera
  - cloth
  - interface_theme
  - operator
  - render
  - ...
- startup
- templates
```

Not all of the folders have to be present.

Save & Load

Relative Paths

By default, external files use a relative path. This works only when a Blender file is saved.

Compress File

Compress `.blend` file when saving.

Load UI

Default setting is to load the Window layout (the [Screens](#)) of the saved file. This can be changed individually when loading a file from the Open Blender File panel of the File Browser window.



File extension filter

Filter File Extensions

By activating this, file dialog windows will only show appropriate files (i.e. `.blend` files when loading a complete Blender setting). The selection of file types may be changed in the file dialog window.

Hide Dot File/Datablocks

Hide file which start with `"."` on file browsers (in Linux and Apple systems, `"."` files are hidden).

Hide Recent Locations

Hides the Recent panel of the File Browser window which displays recently accessed folders.

Show Thumbnails

Displays a thumbnail of images and movies when using the File Browser.

Auto Save

Save Versions

Number of versions created for the same file (for backup).

Recent Files

Number of files displayed in File » Open Recent.

Save Preview Images

Previews of images and materials in the File Browser window are created on demand. To save these previews into your `.blend` file, enable this option (at the cost of increasing the size of your `.blend` file).

Auto Save Temporary File

Enable Auto Save (create a temporary file).

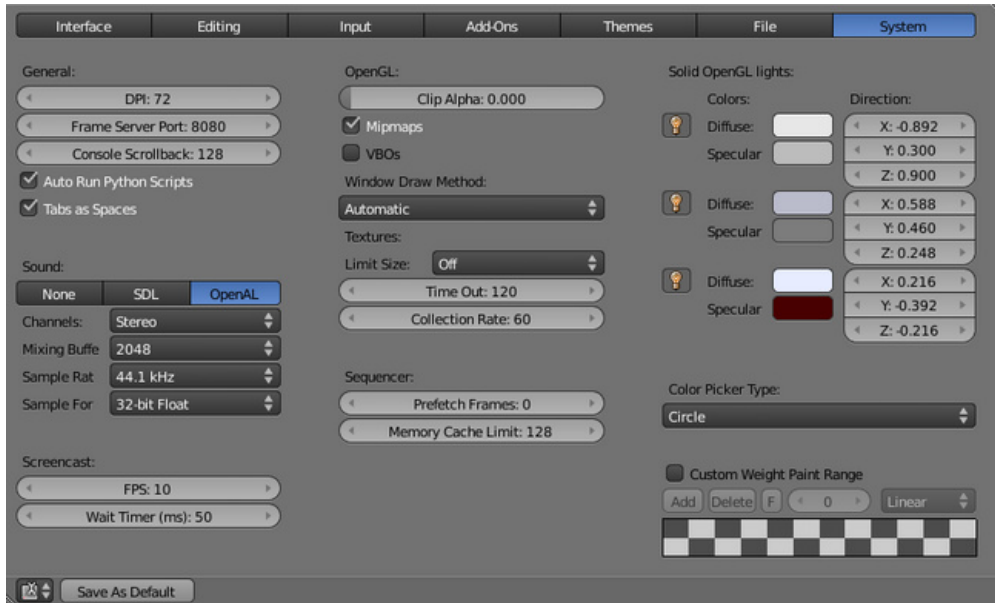
Timer

Time to wait between automatic saves.

[Read more about Auto Save options »](#)

System preferences

The picture shows the System tab in the User Preferences window Blender. The several options are explained below.



General

DPI

This value is the screen resolution and thus controls the size of the interface fonts. To change the size of parts of the interface, you might prefer pressing Ctrl and dragging MMB left and right over a panel to resize its contents.

Frame Server Port

Frameserver port for frameserver rendering. Used when working with distributed rendering.

Console Scrollback

The number of lines, buffered in memory of the console window.

Auto Run Python Scripts

Allows `.blend` files to run their scripts automatically (might be unsafe with files from unknown sources).

Tabs as Spaces

Tabs in text files are converted into spaces while typing or when a text file is loaded.

Sound

Sound

Set the audio output device.

Channels

Set the audio channel count.

Mixing Buffer

Set the number of samples used by the audio mixing buffer.

Sample Rate

Set the audio sample rate.

Sample Format

Set the audio sample format.

Screencast

FPS

Framerate for the screencast to be played back.

Wait Timer

Time in milliseconds between each frame recorded for screencasts.

Open GL

Clip Alpha

Clip alpha below this threshold in the 3D viewport.

Mipmaps

Scale textures for 3D view using mipmap filtering. This increases display quality, but uses more memory.

Anisotropic Filtering

Set the level of anisotropic filtering.

VBOs

Use Vertex Buffer Objects, or vertex arrays if unsupported, for viewport rendering.

Window Draw Method

Automatic

Automatically set based on graphics card and driver.

Triple Buffer

Use a third buffer for minimal redraws at the cost of more memory.

Overlap

Redraw all overlapping regions. Minimal memory usage, but more redraws.

Overlap Flip

Redraw all overlapping regions. Minimal memory usage, but more redraws (for graphics drivers that do flipping).

Full

Do a full redraw each time. Only use for reference, or when all else fails.

Text Draw Options

Enable interface text anti-aliasing.

Limit Size

Limit the maximum resolution for pictures used in textured display to save memory.

Time Out

Time since last access of a GL texture in seconds, after which it is freed. Set to 0 to keep textures allocated.

Collection Rate

Number of seconds between each run of the GL texture garbage collector.

Sequencer

Prefetch Frames

Number of frames to render ahead during playback.

Memory Cache Limit

Limit of the sequencer's memory cache (megabytes).

Solid OpenGL lights

When the display in a 3D Window is switched to Solid view, there are three virtual light sources (you won't see them in renders) used to illuminate the scene. Direction, diffuse and specular lighting of these lights can be changed here.

Miscellaneous

Color Picker Type

Choose which type of color dialog you prefer - it will show when clicking LMB  on any color field.

Custom Weight Paint Range

Mesh skin weighting is used to control how much a bone deforms the mesh of a character. To visualize these weights, Blender uses a color ramp (from blue to green to yellow to red). Here you can create your own. With the Controls beneath the options you can add, delete and change the color of Color stops in this ramp.

Your First Animation in 30 plus 30 Minutes Part I

This chapter will guide you through the animation of a small "Gingerbread Man" character. We will describe each step completely, but we will assume that you have read the [interface](#) chapter, and that you understand the conventions used throughout this book.

In Part I of this tutorial we'll build a *still* Gingerbread Man. Then, in Part II, we will make him walk.

Note

For a much more in-depth introduction to Blender that focuses on character animation, check out the

[Blender Summer of Documentation Introduction to Character Animation](#) tutorial (this is written for V2.4x but still can be very instructive).

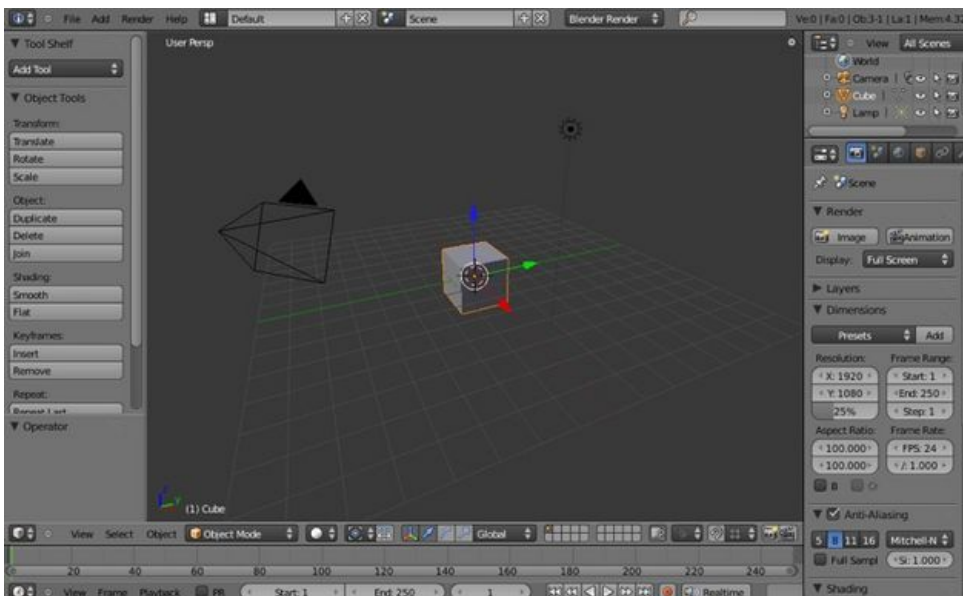


Just like the "Gus the Gingerbread Man" tutorial you see here, the BSoD Intro to Character Animation tutorial assumes no prior knowledge. It guides you through the process of making a walking, talking character from scratch and covers many powerful features of Blender not found here.

The BSoD Intro to Character Animation also has a downloadable [PDF version \(3.75 MB\)](#) for offline viewing.

Warming up

After starting Blender, you should see the Default screen set up. The 3D view in the centre displays a camera, a light, and a cube. The cube should already be selected, as indicated by its orange outline.



Default Blender screen.

We will start by organizing our working area by placing Objects on different layers. 3D scenes can quickly become confusing when multiple Objects are on the screen. With layers, you can hide Objects you aren't working on and make them visible when you need them.



Layer visibility

controls.

Blender provides you with twenty layers to help organize your work. You can see which layers are currently visible from the group of twenty buttons in the 3D window header (see *Layer visibility controls*). You can change the visible layer with LMB and manage the visibility of multiple layers with ⇧ Shift LMB. Visible layers are indicated by a darker gray color in the layer visibility controls. The last layer that is made visible becomes the active layer. The active layer is also where all new Objects will be stored.

[Read more about layers »](#)

Let's clean up the screen by first moving the camera and lamp to another layer.



The Move to Layer popup.

Select the Camera with RMB. Then add the Lamp to the selection with ⇧ Shift RMB. Press M and a small toolbox, like the one in (*The Move to Layer popup*) will appear beneath your mouse with the first button checked. This means that the selected objects are stored in layer 1. Click the rightmost button on the top row. This will move your Camera and Lamp to layer 10.

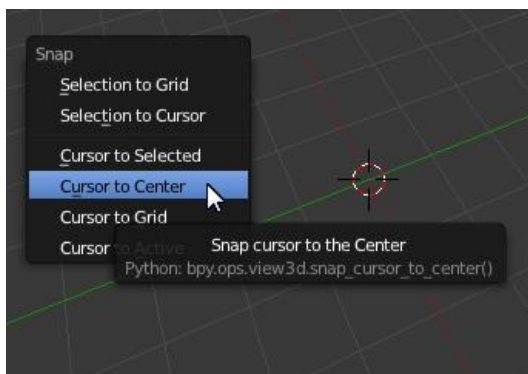
Keyboard Shortcuts

Blender is mainly controlled with lots of keyboard shortcuts (don't panic, you'll get used to it). Most of those shortcuts only work while the mouse pointer hovers above the corresponding frame. So don't get frustrated if M doesn't do what it's supposed to do – just move the mouse into the 3D view.

Now make sure that only Layer 1 is visible (colored a darker gray in the layer visibility controls) so that we can start modeling.

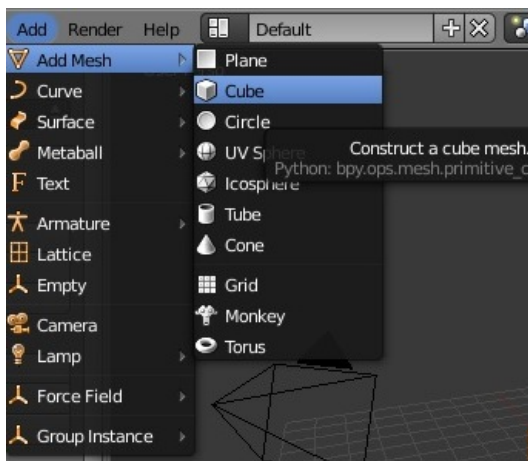
Building the body

With Num lock activated, change to the front view with 1 NumPad and to orthogonal view with 5 NumPad. The upper left corner of the 3D window will tell you whether you are in orthogonal or perspective view.



Snap cursor to the Center

If you don't have a Cube on your screen we'll need to add one. Snap your cursor to the center (0,0,0) of the screen by Object » Snap » Cursor to Center or using the ⇧ ShiftS shortcut.

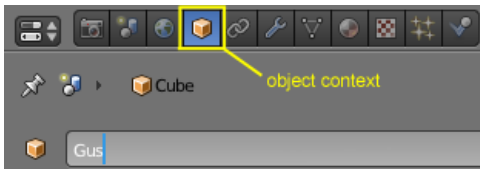


Add a cube to the scene.

Then add a Cube with Add » Add Mesh » Cube or using the ⇧ ShiftA shortcut. A cube will appear displayed in orange to indicate that it is the active Object. Press ⇧ Tab to enter Edit Mode.

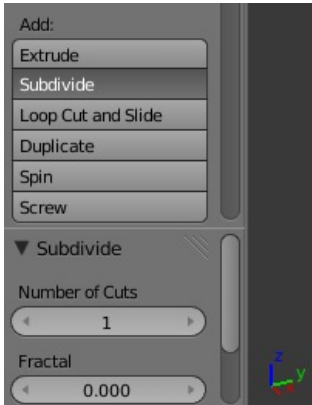
Edit Mode is a mode in which you can edit the vertices of the mesh. By default, all vertices are selected for every new Object created

(selected vertices are highlighted in orange, unselected vertices are black). In Object Mode, vertices cannot be selected or edited individually; the Object can be changed only as a whole. You can press \leftrightarrow Tab to switch between these two modes. The current mode is indicated in the header of the 3D window.



Naming Gus

We will call our Gingerbread man "Gus". To do so, switch to the object-context (See *Naming Gus*) which can be found on the Properties Window on the right hand side. You can rename Gus on the first line.



Part of the Tool Shelf

Our first task is to build Gus's body by working on the vertices of our cube. Tools to do this can be found on the Tool Shelf, which is a part of the 3D Window (on the left hand side of the screen). If you can't see the Tool Shelf, simply press T.

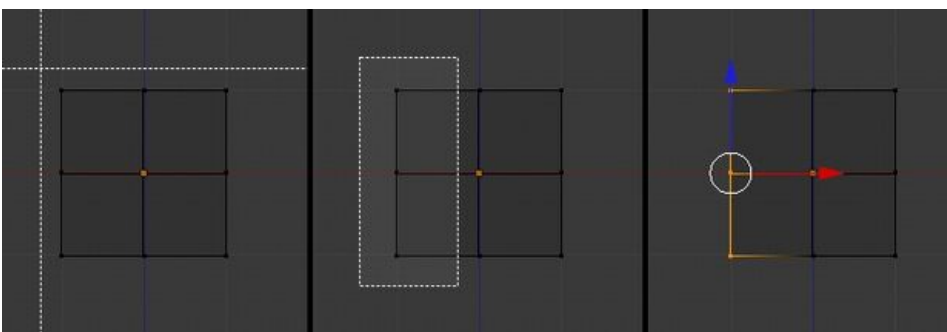
Now locate the Subdivide button in the Tool Shelf (under Add) and press it once. This will split each side of the cube in two, creating new vertices and faces. The result is illustrated below. If you want to get the same view, change to perspective with Num5 and rotate the view by clicking and dragging with MMB . Don't forget to change the view back with Num1 (Front View) and Num5 (Perspective/Orthographic).



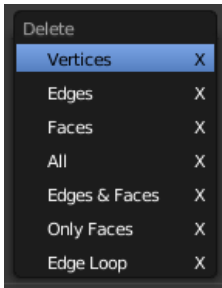
With your cursor hovering in the 3D window, press A to deselect all elements. Vertices will turn black.

You must have the Limit Selection to Visible button *unselected* to continue this tutorial.

Now press B to activate Box Select/Border Select mode. The cursor will change to a couple of orthogonal grey lines. Move the cursor above the top left corner of the cube, press and hold LMB , then drag the mouse down and to the right so that the grey box encompasses all the leftmost vertices. Now release the LMB .



The sequence of Box selecting a group of vertices.



The pop-up menu of the Delete (X) action.


Press X, and from the popup menu select Vertices to erase the selected vertices.







Selection Behavior and Limit Selection to Visible

Especially when in orthographic view (toggled via 5 NumPad), there may be vertices hidden behind other vertices.

For example, our subdivided cube has 26 vertices, yet in orthographic front view you can only see nine of them because the others are hidden.

A RMB  click selects only one of these stacked vertices, whereas a box select selects them all. This is true as long as either the Bounding Box or Wireframe display method is active. If the chosen method is Solid or Textured, the Limit Selection to

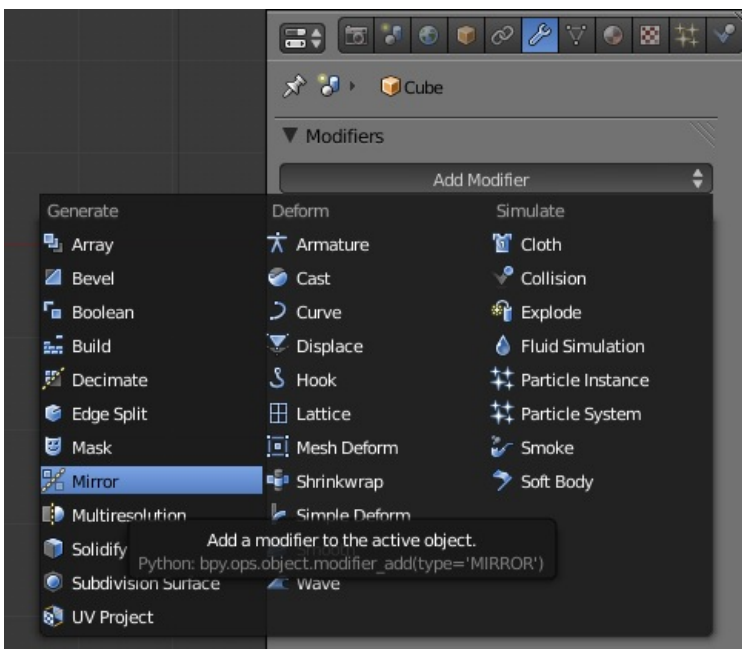
Visible button  has to be deactivated or only visible vertices will be selected. (The Limit Selection to Visible button can be found on the 3D window header when either the Solid or Textured display method is active.)

Another tool to select or deselect vertices is Circle Select, which can be activated by pressing C. When the Circle Select tool is active, clicking or dragging with LMB  selects vertices. MMB  deselects vertices. Using the mouse-wheel changes the size of the selection-circle. RMB  or ↵ Enter finalizes the selection and exits Circle Select mode. Just give that alternative a try after you deleted the vertices as mentioned above.

Mirror modelling

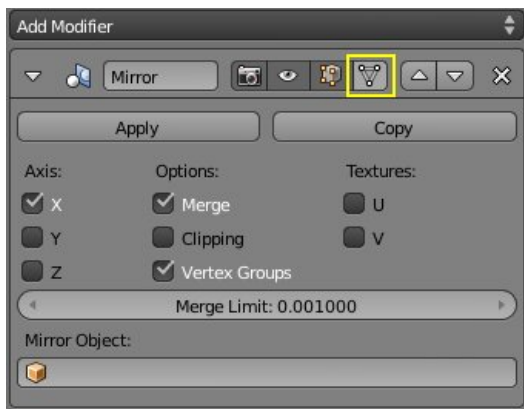
To model symmetrical objects we can use the Mirror modifier. It allows us to model only one side of Gus while Blender creates the other in real time. Go to the Properties editor and find the Modifiers context.

[Read more about modifiers »](#)



The modifiers context

It is pretty empty for the moment. Clicking the button marked Add Modifier opens a list where you can choose Mirror.



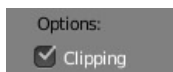
Cage Mode button.

In addition to affecting Objects in a non-destructive manner, modifiers also allow you to control what is displayed when you are working with them. In our case we will check the Cage Mode button so we can see the transparent mirrored faces in Edit Mode.

We then choose the axis to mirror Gus along by checking either the X, Y or Z button. The mirror plane will be perpendicular to that axis. In our case it is the X-axis.

The Merge button will merge any mirrored vertices that are equal to or closer than the distance specified by the Merge Limit slider. Essentially any mirrored vertex closer to the mirror plane than the limit we set will be placed exactly on the mirror plane and merged with the corresponding vertex. The limit can be set from **0.000** to **1.000** units and how big it should be depends on the nature and the scale of the current job.

For modeling Gus, a vertex that is more than **0.1** units away from the mirror plane would be noticeable but anything closer might not be visible. To prevent a large rip showing up in the middle of our mesh or cause us to neglect a wandering vertex, we should set the Merge Limits to **0.1**.



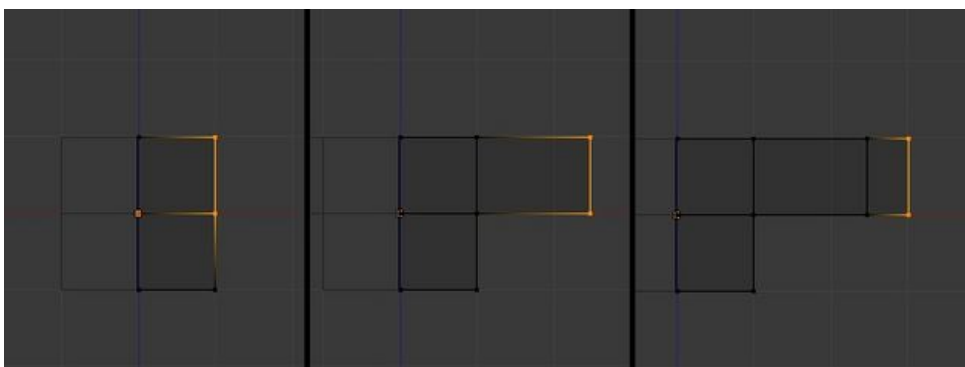
Clipping button.

Finally, with the Clipping button checked, the mirror plane becomes a border that no vertex can cross. Also, when Clipping is active, every vertex that is **on** the mirror sticks to it.

As you can see, the Mirror modifier gives us a lot of features to make our lives easier.

Arms and Legs

Let's create Gus's arms and legs. Using the sequence you just learned, Box Select the two top-right-most vertices (*Extruding the arm in two steps*), which will actually select the other four behind them, for a total of six vertices. Press E to extrude them (or use the Extrude Region button in the Tool Shelf). This will create new movable vertices and faces which you can move with the mouse. Move them one and a half squares to the right, then click LMB to fix their position. Extrude again with E then move the new vertices another half a square to the right. The image below shows this sequence.



Extruding the arm in two steps.

Undo/Redo


Blender has two Undo features, one for Edit Mode and the other for Object Mode.

In Edit Mode press CtrlZ to Undo and keep pressing CtrlZ to roll back changes as long as the Undo buffer will allow; ⇧ ShiftCtrlZ re-does changes. On Macs use ⌘ Cmd instead of Ctrl.


Two things to remember:

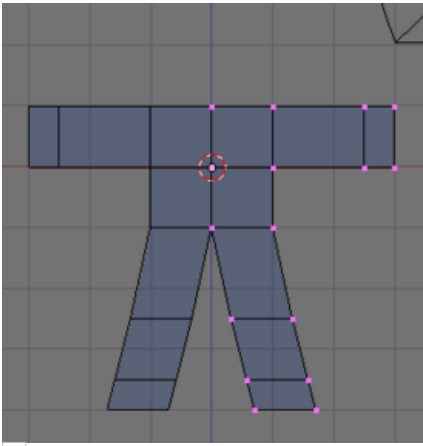
- Undo in Edit Mode works only for the Object currently in that mode.
- Undo data is not lost when you switch out of Edit Mode, but it is as soon as you start editing a *different* Object in Edit Mode.

In Object Mode the same shortcuts apply. CtrlZ to undo, ⇧ ShiftCtrlZ to redo. If you made changes in Edit Mode that are not lost for that Object, they will all be undone in one single shot with CtrlZ when this step has its turn.

If you change your mind in the middle of an action, you can cancel it immediately in many cases and revert to the previous state by pressing Esc or RMB .


Coincident vertices

Extruding works by first creating new vertices and then moving them. If in the process of moving you change your mind and press Esc or RMB  to cancel, the new vertices will still be there, on top of the original ones! The simplest way to go back to the state before you started extruding is to Undo (CtrlZ). It is sometimes useful to intentionally create new vertices this way and then move, scale or rotate them by pressing G,S or R.



Body.

Gus should now have a left arm that you modeled (he's facing us) and a right arm that Blender added. We will build the left leg the same way by extruding the lower vertices three times. Try to produce something similar to the *Body* image shown to the right. If you are using *Extrude - Region*, you will have to temporarily turn off the Mirroring modifier by unchecking the X option under Axis, and rechecking it after extruding (otherwise Gus will end up with a skirt rather than pants).

You can free the movement of the extruding vertices by clicking MMB  after you have pushed E but before you click LMB . If you do not do this your legs will end up going straight down, rather than down and to the side as pictured in *Body*.


Tip: If you want to position exactly, hold down Ctrl while moving things around.

We're done with mirror modeling. In the next steps we will experiment with other techniques. We need to make the right part of our model *real* since nothing done with modifiers is permanent unless we *apply* the changes. With Gus being in Object Mode (press ⇧ Tab if he's still in Edit Mode), click on the *Apply* button of the Mirror modifier.

The Head

Gus needs a head.



Change back to Edit Mode (press ⇧ Tab)

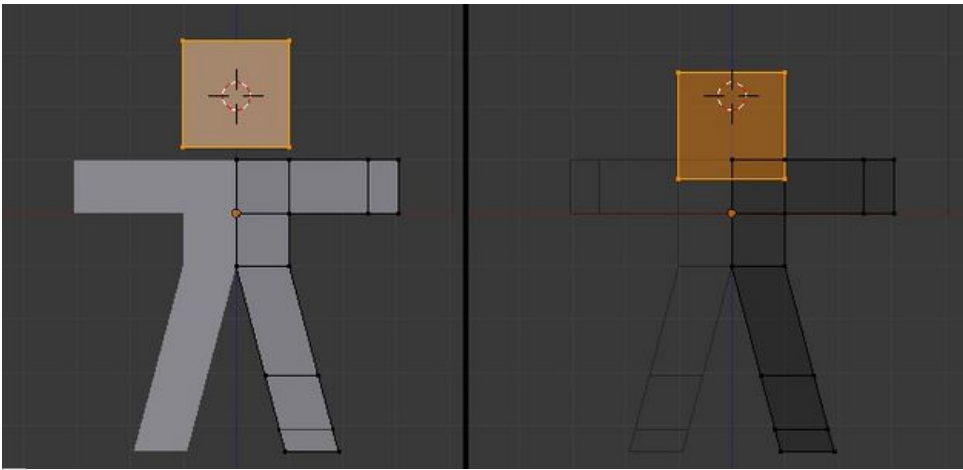
Move the cursor to exactly one square above Gus's body. To place the cursor at a specific grid point, LMB  click to position the cursor near where you want it and then press ⇧ ShiftS to bring up the Snap Menu. Cursor to Grid places the cursor exactly on a grid point. That's what we want right now. Cursor to Selection places it exactly on the selected object, which is sometimes handy.

Add a new cube for Gus' head (⇧ ShiftA >> Add >> Cube) (leftmost image of *Adding the head*).

Object Creation

When you add an object while in Edit Mode for another object, the new object becomes part of the existing object. So by adding this cube while we have Gus' body in edit mode, it's automatically part of him.

Now press G to switch to Grab Mode and move the newly created cube down. You can constrain the movement to a straight line by moving the head down a bit and then clicking MMB . Move Gus' new head down about one third of a grid unit then press LMB  to fix its position (rightmost image of *Adding the head*).



Adding the head.

SubSurfaces (*Subsurf*)



The Subsurf modifier

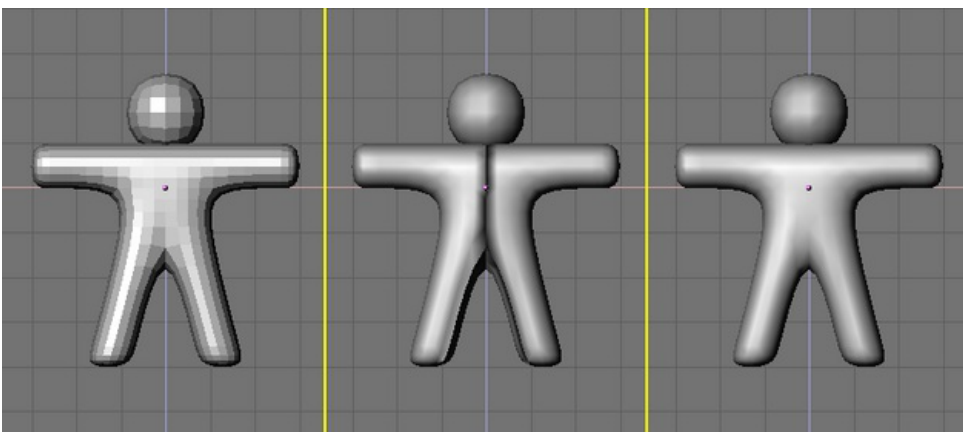
For the next step, we'll need to select all of Gus, and not just his head (use A - maybe twice).

So far what we have produced is a rough figure at best. To make it smoother, locate the Modifier context and add a Subdivision Surface modifier, (*The Subsurf modifier*). Be sure to set both the View and Render NumButtons (located under Subdivisions) to values at or below 2. View sets the level of subdivision you'll see in the 3D viewport; Render sets the level of subdivision used by the renderer.

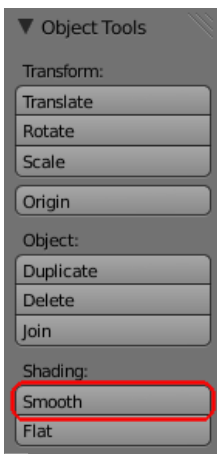
SubSurfaces

SubSurfacing is an advanced modelling tool that dynamically refines a coarse mesh. It works by creating a much denser mesh and locating the vertices of this finer mesh so that they follow the original coarse mesh smoothly. The shape of the object is still controlled by the location of the coarse mesh vertices, but the rendered shape is a finely smooth mesh.

To have a look at Gus, switch out of Edit Mode (⇐ Tab) and to Solid display mode using Z (in the case it isn't active). He should look like (*Setting Gus to smooth*).




Setting Gus to smooth

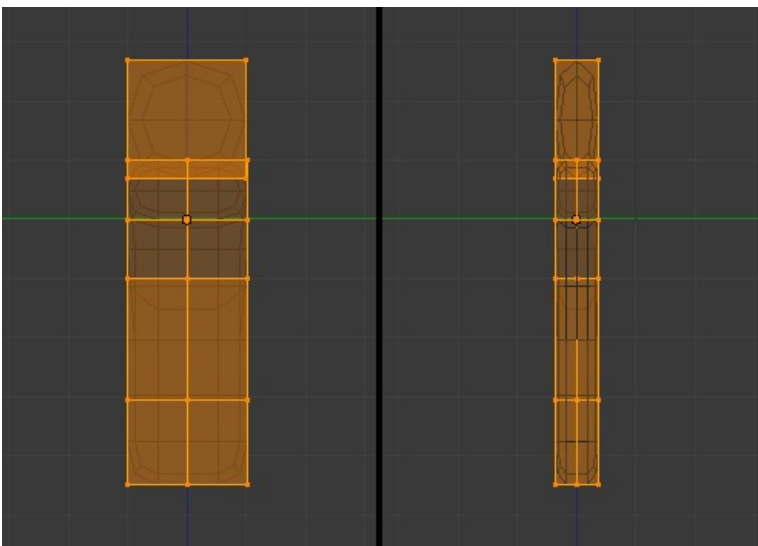


Object Tools.

To make Gus look smooth even smoother, press the Smooth button found under Shading in the Tool Shelf of the 3D Window (T). Gus will now appear smooth, although he may wear some funny black lines in his middle. This is usually avoided if you used the Mirror modifier, but it might happen when extruding and flipping as was done before the Mirror modifier was introduced (*Setting Gus to smooth*., middle). These lines appear because the SubSurf's finer mesh is computed using information about the coarse mesh's normal directions (the direction perpendicular to a face), which may not all point in the right direction (some face normals might be pointing outward and some pointing inward). To reset the normals, switch back to Edit Mode (\leftrightarrow Tab), select all vertices (A), and press Ctrl+N. Now Gus should be nice and smooth (*Setting Gus to smooth*, right).

Press MMB  and drag the mouse around to view Gus from all angles. Oops, he is too thick!

Constrained Scaling



Slimming Gus using constrained scaling

Let's make Gus thinner:



Parameters of the last action in the Tool Shelf

- Switch to Edit Mode if you are not there already (\leftrightarrow Tab), then back to Wireframe mode. (Z), Switch to side view using Num3 and select all vertices with A. You can do the following steps just as well in Object Mode, if you like.
- Press S and start to move the mouse horizontally. (Click MMB to constrain scaling to just one axis or press Y to obtain the same result). If you now move the mouse toward Gus he should become thinner but remain the same height.
- The header of the 3DWindow toolbar shows the scaling factor. Press and hold Ctrl: the scale factor will now change in discrete steps of 0.1. Scale Gus down so that the factor is 0.2, then set this dimension by clicking LMB . If that last transformation went wrong you can still change it's parameters. They are shown at the bottom of the Tool Shelf (see *Parameters of the last action in the Tool Shelf*).
- Return to Front view (Num1) and to Solid mode (Z), then rotate your view via MMB . Gus is much better now!

Let's see what Gus looks like

We're just about ready to see our first rendering, but first, we have some work to do.

- Switch to Object Mode if not already there (\leftrightarrow Tab).

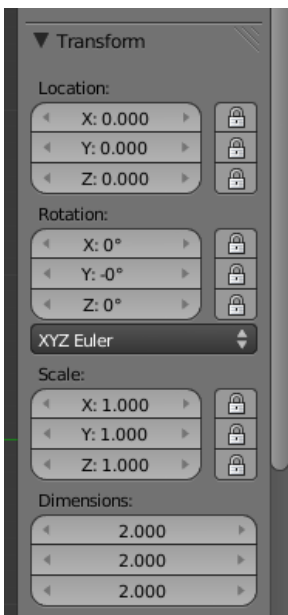


Making both layer 1 and 10 visible.



- \uparrow Shift LMB on the top right small button of the layer visibility buttons in the 3DWindow toolbar (*Making both layer 1 and 10 visible.*) to make both Layer 1 (Gus's layer) and Layer 10 (the layer with the camera and the lamp) visible.

A Tip



Remember that the last layer selected is the active layer, so all subsequent additions will automatically be on layer 10.

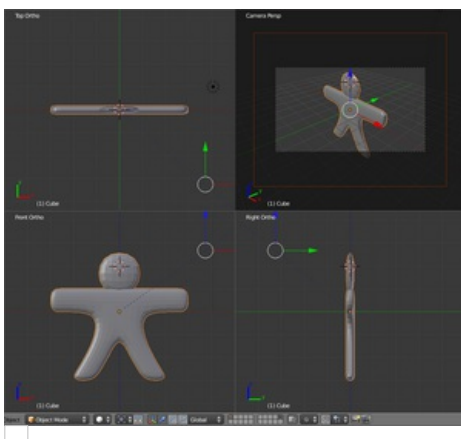


The Transform Panel

- Press N to bring up the Properties Shelf and find the Transform panel there (*The Transform Panel*). The location is specified by the X,Y,Z values.
- Select the camera (RMB ) and move it to a location like (x=7, y=-10, z=7). Do this by pressing G and dragging the camera. You may need to change views and move the camera a second time to adjust all three coordinates. If you prefer to enter numerical values for an object's location you can do so by clicking LMB  on a Value and then entering the desired value.

Camera setup

To make the camera point at Gus, keep your camera selected then select Gus via  Shift RMB . The camera should be dark orange (selected) and Gus light light orange (selected and active). Now press CtrlT and select the TrackTo Constraint entry in the pop up. This will force the camera to track Gus and always point at him. This means that you can move the camera wherever you want and be sure that Gus will always be in the center of the camera's view.



Camera position with respect to Gus.

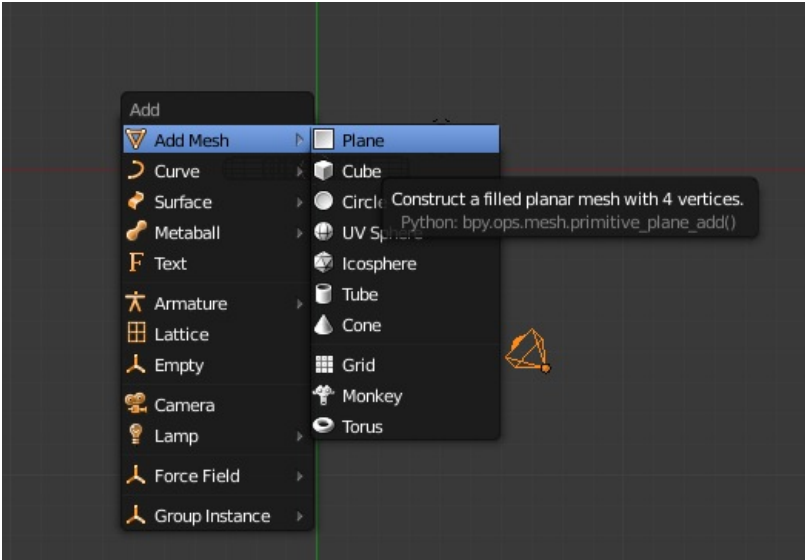
(*Camera position with respect to Gus*) shows top, front, side and camera view of Gus. To obtain a camera view press 0 NumPad or select View>>Camera. To get a Quad View as shown in the picture, press CtrlAltQ or select View>>Quad View.

The Ground

Now we need to create the ground for Gus to stand on.

- In top view (7 NumPad or View>>Top), and in Object Mode, add a plane

- Add a plane (⇧ ShiftA or >>Add>>Mesh>>Plane).



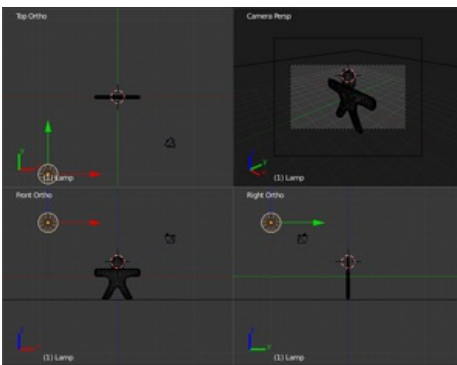
Note

It is important to be out of Edit Mode, otherwise the newly added object would be part of the object currently in Edit Mode, as when we added Gus' head.

- Switch to Front view (1 NumPad or View>>Front) and move (G) the plane down to Gus's feet, using Ctrl to keep it aligned with Gus.
- Go to Camera view (0 NumPad or View>>Camera) and, with the plane still selected, press S to start scaling.
- Enlarge the plane so that its edges extend beyond the camera viewing area, as indicated by the lighter area in the camera view.

Lights

Now, lets add some light!



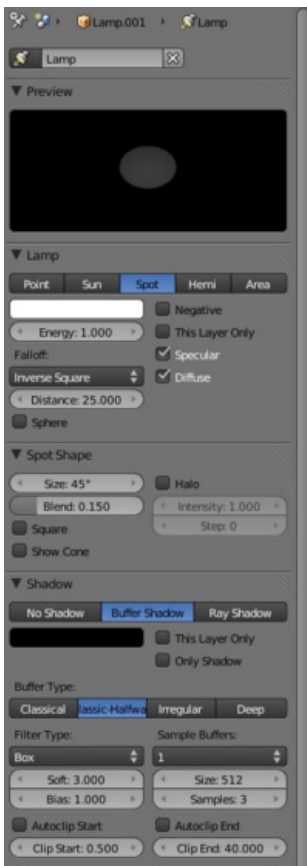
Inserting a Lamp

- In Top view (7 NumPad), move the existing Lamp light (if you do not have a Lamp light in your scene you can add one with ⇧ ShiftA >>Add>>Lamp>>Lamp) in front of Gus, but on the other side of the camera; for example to (x= -9, y= -10, z=7) (*Inserting a Lamp.*).



The object data button of a lamp

- When the lamp is selected in Object Mode, select the Object Data icon in the properties window (looking like a small sun). You will see a Lamp submenu, with Point, Sun, Spot, Hemi, and Area choices. (*The object data button of a lamp.*)



The Spot light settings

- In the Properties Window Lamp Panel, press the Spot toggle button to make the lamp a Spotlight (*The Spot light settings.*) of pale yellow (R=1, G=1, B=0.9) by clicking on the white button, which is actually a color picker. Adjust Size under Spot Shape to about 40 and Blend: to 1.0.
- Make this spotlight track Gus just as you did for the camera by selecting Spot, ⇧ Shift, then Gus, then by pressing CtrlT>>TrackTo Constraint.
- Add a second lamp that provides more uniform fill light (⇧ ShiftA >>Add>>Lamp>>Hemi). Set its Energy to 0.2 (*Hemi lamp settings*). Move it a little above the camera (x= 7, y= -10, z=9) and set it to track Gus as before.

Two lamps?

Use two or more lamps to help produce soft, realistic lighting, because in reality natural light never comes from a single point.

Rendering



The Render context button

We're almost ready to render. As a first step, press the Render context button in the Properties window header (*The Render context button*).



The Render context

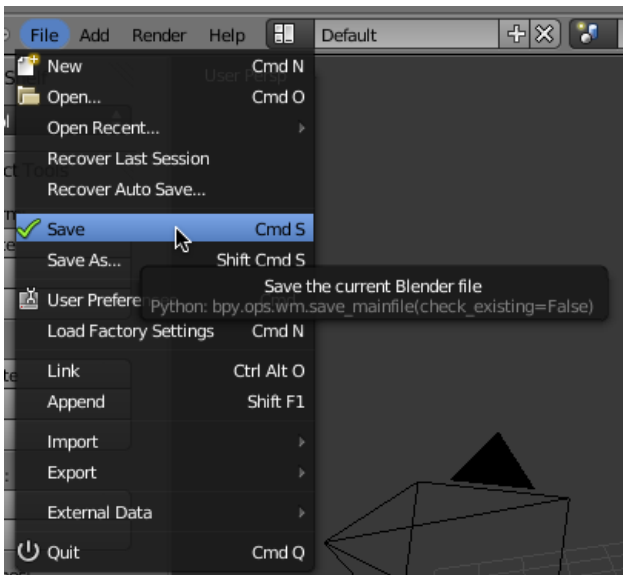
We will use the default rendering settings, as shown in (*The Render context*).

Now press the Image button or F12. The result, shown in (*Your first rendering. Congratulations!*), is actually quite poor. We still need materials, and lots of details, such as eyes, and so on. When you're done looking, press F11 to hide the render view.



Your first rendering. Congratulations!

Saving our work



The Save menu

If you have not done so already, now would be a good time to save your work, via the File>>Save menu shown in *The Save menu.* or *CtrlS*. Blender will warn you if you try to overwrite an existing file.

Blender does automatic saves into your system's temporary directory. By default, this happens every five minutes and the file name is a number. Loading these saves is another way to undo unwanted changes.

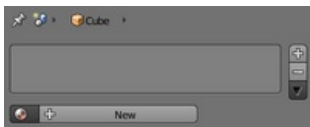
Materials and Textures

It's time to give Gus some nice cookie-like material.



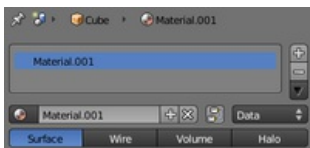
The Material context Button.

- Select Gus. Then, in the Properties Window header, select the Materials button (*The Material context Button.*) to access the Material panels.



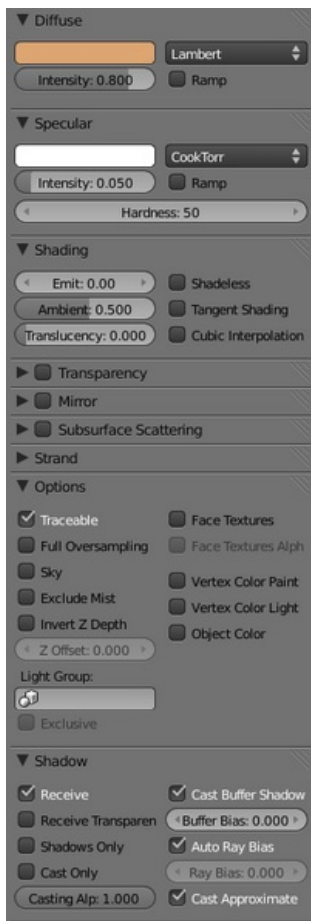
The (almost) empty Material context

- The Properties window will be almost empty because Gus has no materials yet. To add a material, click on the + *New* button in the Material Panel (*The (almost) empty Material context*).




Top of the filled material context

- The Properties window will then be populated by Panels and Buttons. A string holding the Material name, generally "Material.001", will appear in the list box as well as in the Unique Datablock ID box. Click the name in the latter (in the lower part of Top of the filled material context) and change it to something meaningful, like "GingerBread" (don't type the quotes).



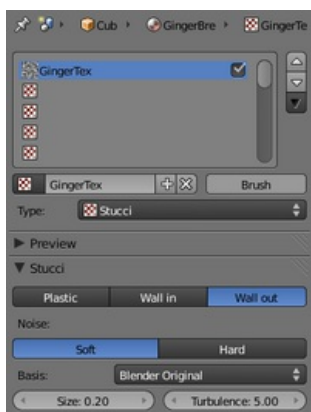
A first gingerbread material.

- Modify the default values as per (*A first gingerbread material*) to obtain a first rough material. Note that you may have to expand some panels by clicking LMB  on the small triangle besides their header.



The Texture context button

- Press the Texture context Button in the Properties window header (*The Texture context button*) and select Add new. We're adding a texture in the first channel. Call it "GingerTex."



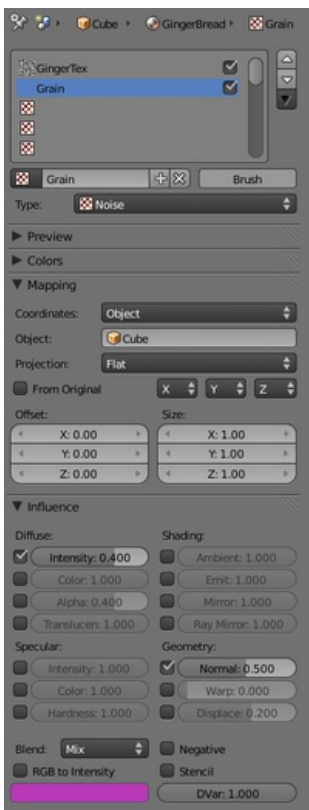
The Texture context

- Change the Type from Clouds to Stucci and set all parameters as in (*The Texture context*).



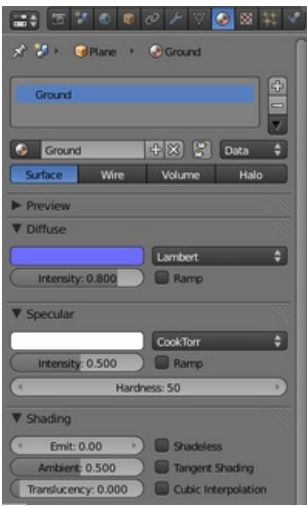
Settings for the Stucci texture

- Set the Mapping and Influence panel of the Texture context as in (*Settings for the Stucci texture*): Deselect the Color Checkbox and set the Normal Checkbox, then change the Normal slider to **0.75**. These changes will make our Stucci texture act as a "bumpmap" and make Gus look more biscuit-like.



Settings for an additional Noise texture

- Now select the second line in the Texture list of the Texture context and add a second texture. Name it "Grain", and adjust the settings to match (*Settings for an additional Noise texture*). The texture itself is a plain Noise texture.



A very simple ground material


- Give the ground an appropriate material, such as the dark blue one shown in (*A very simple ground material*). Feel free to choose your favorite shade of blue.

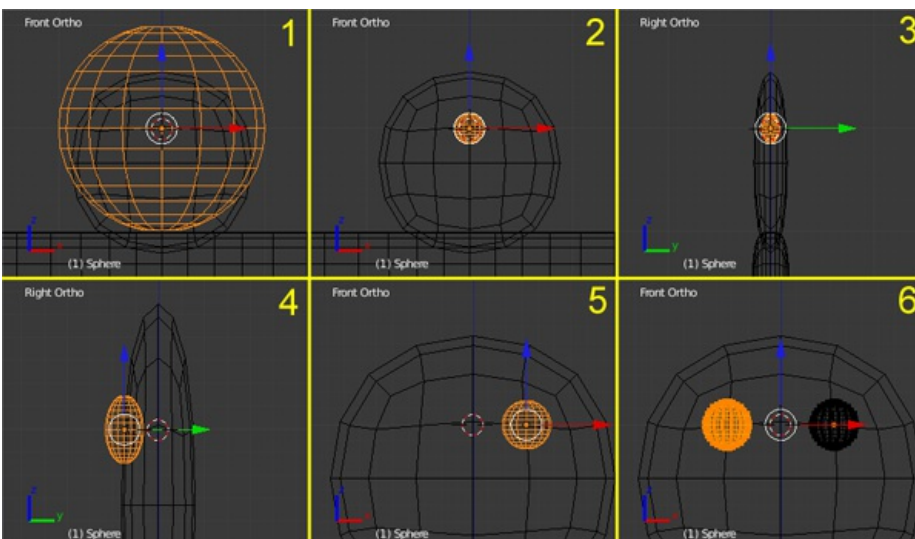
Eyes and detail

To give some finishing touches we'll add eyes and some other details.



Layer visibility

- First make Layer 1 the only one visible by clicking with LMB  on the layer 1 button (*Layer visibility*). This will hide the lamps, camera, and ground.
- Place the cursor at the center of Gus's head. (Remember that you are in 3D so be sure to check at least two views to be sure!)
- In Object Mode, add a sphere (⇧ ShiftA >>ADD>>Mesh>>UVsphere). Press F6 and change the number of segments (meridians) to 16. You can see the result under 1 in *Creation of the eyes*.
- Scale the sphere down (S) to a factor of about **0.15** in all dimensions, then switch to side view (3 NumPad) and scale it only in the horizontal direction (Y) a further **0.5** (see the images 2 and 3 in *Sequence for creation of the eyes*).

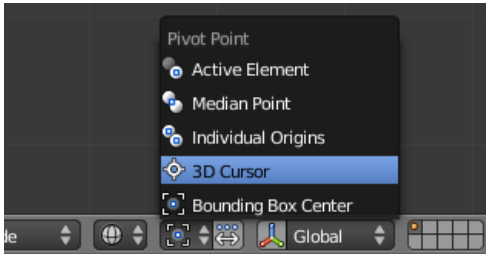


- Zoom a little if necessary via + NumPad, Wheel , or Ctrl MMB , and drag the sphere (G) to the left so that it is halfway into the head, as shown in image 4 of *Creation of the eyes*.

- Return to front view (1 NumPad) and move the sphere sideways, to the right. Place it where Gus should have an eye (picture 5 in *Creation of the eyes*).

Flipping a duplicate around the cursor

- Switch to Edit Mode (⇧ Tab). Select the crosshair pivot button (*pivot: 3D Cursor*) in the header of the 3D window (the 3D Transforms Manipulator jumps from the sphere to the cursor). All vertices of the eye should be selected (if not, press A to select all), now press ⇧ ShiftD or use Duplicate in the Tool Shelf to duplicate and Esc to stop placing the copy with the mouse.



Pivot: 3D Cursor

- Press CtrlM to mirror, X to mirror around the X axis, followed by LMB or ↵ Enter to confirm the mirror. Return the pivot button to its default setting (Median Point). The result can be seen in picture 6 of *Creation of the eyes*.

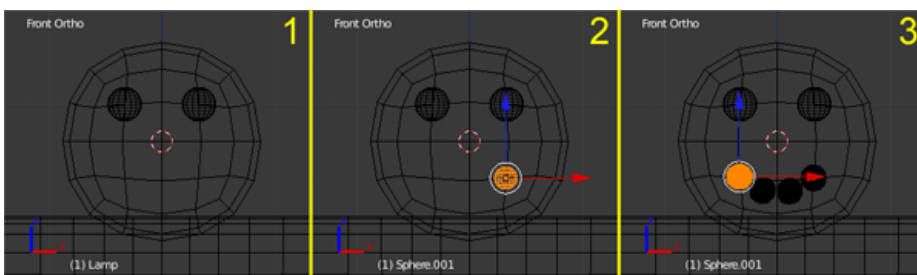
Mirroring

Mirroring is also possible in object mode using CtrlM.

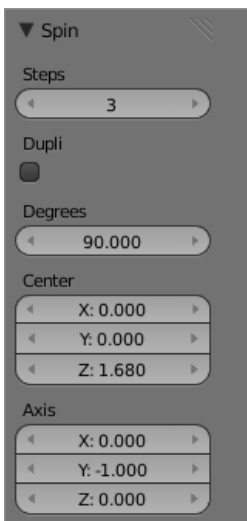
Now Gus has two eyes.

Mouth


- Exit Edit Mode (⇧ Tab), and place the cursor as close as you can (remember the ⇧ ShiftS key) to the center of Gus's face. Add a new sphere and scale and move it exactly as done before for the eyes, except make its allover scale smaller (0.1 instead of 0.15). Place it below and to the right of the cursor, centered on the SubSurfed mesh vertex, as shown in picture 2 of *Creating a mouth with the Spin tool*.



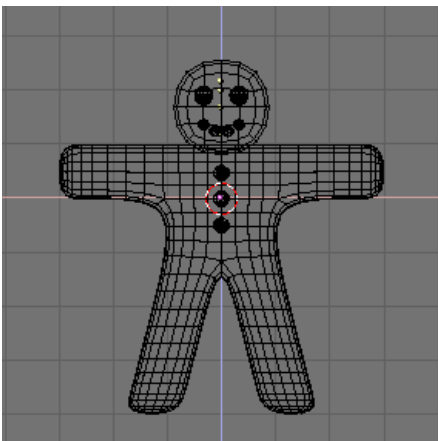
Creating a mouth with the Spin tool



The Spin Tools options on the Tool Shelf

- Switch to Edit Mode (⇧ Tab). Now use AltR or LMB  on Spin on the Tool Shelf. Several copies of the sphere appear.
- On the lower Tool Shelf, (Press F6 if not visible), set the details of the Spin: Set Degr: to **90**, Steps: to **3**. The result should be Gus's mouth, like image 3 in *Creating a mouth with the Spin tool*.

(EDIT REMARK: The properties of the last command (as *Spin* in the above descriptions) don't show in every 3D window (at least in the editors Version of Blender (V2.5 beta, Mac)) so don't panic - it is there somewhere (at least in the default screen))



The complete Gus!

- Now go back to Object Mode and add three more spheres (below the head and centered along the Z-axis) to form Gus's buttons. Once you have made one button, you can simply exit Edit Mode, press ⇧ ShiftD to create a duplicate, and move the duplicate into place, as shown in *The complete Gus!*.

Attaching the spheres

If we want to be able to grab Gus and move him around as a whole (this goes beyond the animation in the second part of this tutorial), we now need to attach the small spheres representing eyes, mouth, and buttons to the body. Enter Object Mode and press A until nothing is selected. Now right click one sphere (if more than one is selected as a group, that's ok). Holding ⇧ Shift, select the body. Then hit CtrlP and left click Object on the pop up. Deselect everything and repeat the process to attach each element.

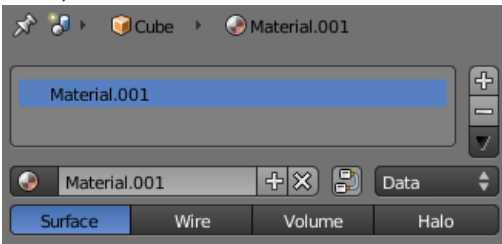
Eyes material

Give the eyes a chocolate-like material. Give the mouth a white sugar-like material, and Gus's buttons could use a bit of color too. Remember what you did when giving a material to Gus himself and be a bit creative; soon Gus will show top-notch gingerbread fashion.

Objects sharing a material

To give one object the same material as another object (i.e. reusing the white material of the mouth on one of the buttons), select that material in the **Material Menu** list which appears when you press the button Browse ID Data besides the Data Block ID Name in the

Material context of the Properties window (In *Material context* the checkered little sphere shown besides *Material.001* is what you need).



Rendering

Once you have finished assigning materials, make layer **10** visible again (remember how? Hint, look at the 3D window header), so that lights and the camera also appear, and do a new rendering (F12).

The result should look more or less like (*The complete Gus still rendering*).



☐ The complete Gus still rendering.

Saving

Save your image by using F3 in the UV/Image Editor that is showing the render result. Enter the name of your image in the file window, choose a destination and save.

You can choose the image format (JPEG, PNG, and so on) by setting it in the shelf to the right of the File Browser.

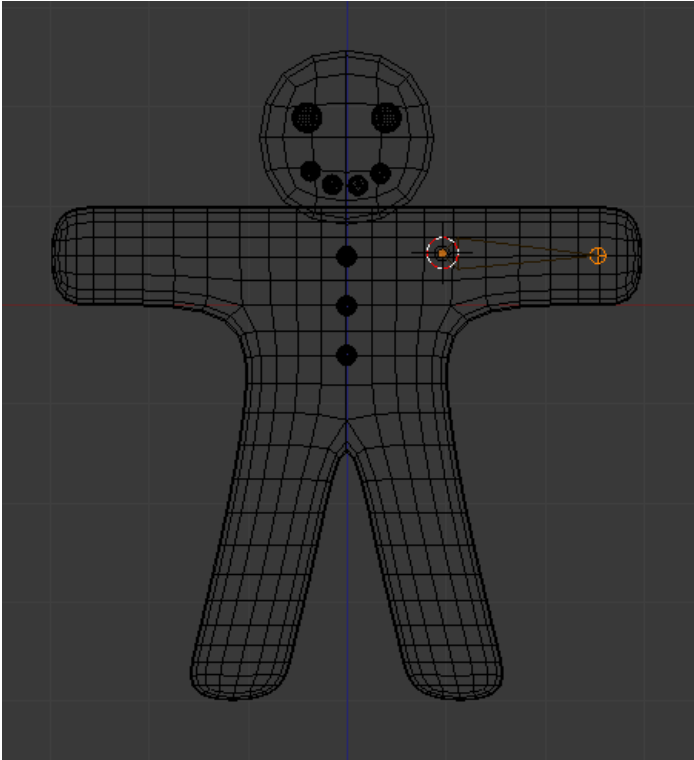
Blender adds an extension to the file name; as you are probably used to (this is new in V2.5, in V2.4x you had to do it manually).

Your First Animation in 30 plus 30 Minutes Part II

If we were going for a still picture, our work up to this point would be enough, but we want Gus to move! The next step is to give him a skeleton, or armature, which will move him. This is called the fine art of rigging. Gus will have a very simple rigging: four limbs (two arms and two legs) and a few joints (no elbows, only knees), but no feet or hands.

Rigging

To add the rigging:



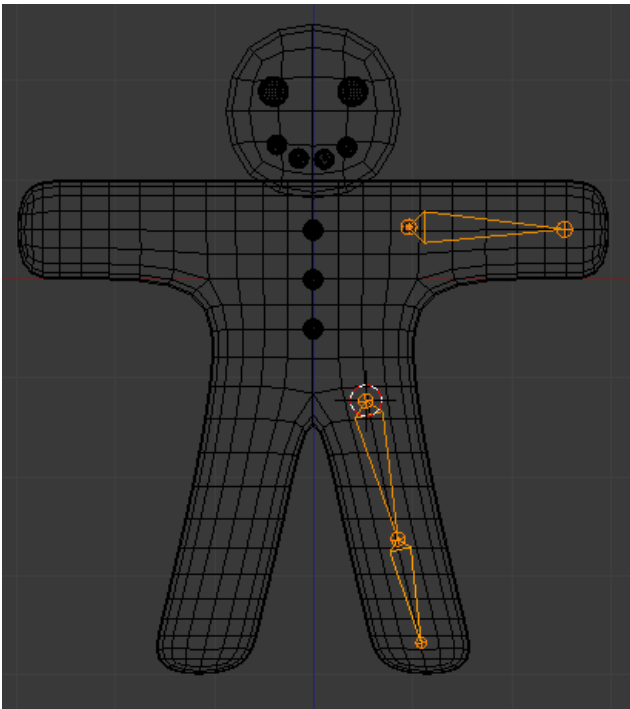
Adding the first bone, an elbowless arm.

- In Object mode, set your 3D cursor where Gus's shoulder is, and press **⇧ ShiftA >> Add >> Armature >> Single bone**. A rhomboidal object will appear, which is a bone of the armature system. Enter Edit mode. The end, or *tip*, of the bone is selected (yellow).
- Now in Edit mode, place the tip of the bone in Gus's hand by grabbing (**G**) and moving it, (*Adding the first bone, an elbowless arm*). We don't need any other bones right now. You should now have one bone running from the shoulder to the hand area. As you move the tip, you will notice that the whole bone gets bigger – you really are scaling up the bone.

To make the process more successful, please periodically look at the Gingerbread man and armature from many different viewpoints to make sure the armature is *inside* the gingerbread man, just as bones are inside a human body. Skinning will fail if the bones are for example in front or in back of the body. Inspection from many different viewpoints is a common 3D model creation technique.

About Bones' Ends

Bones' ends can have different names. In Blender, currently they are called "head"/"tail" (the first being the "large" end, and the second the "thin" end). However, historically, they have been named "root"/"tip", which is often considered somewhat less confusing...



Adding the second and third bones, a leg bone chain.

- Stay in Edit mode, then move the cursor to where the hip joint will be and add a new bone ⇧ ShiftA.
- Grab (G) and move the yellow tip of the new bone to the knee area.
- Now “chain” a new bone from the knee to the foot by Ctrl LMB clicking in the area of the foot. A new *chained* bone will appear automatically linked with the knee and ending at the foot, (*Adding the second and third bones, a leg bone chain*). Another way of chaining the new bone would be to extrude using the E shortcut. This variation creates the new bone and places you in grab mode automatically. Click LMB to validate the current bone's tip position.

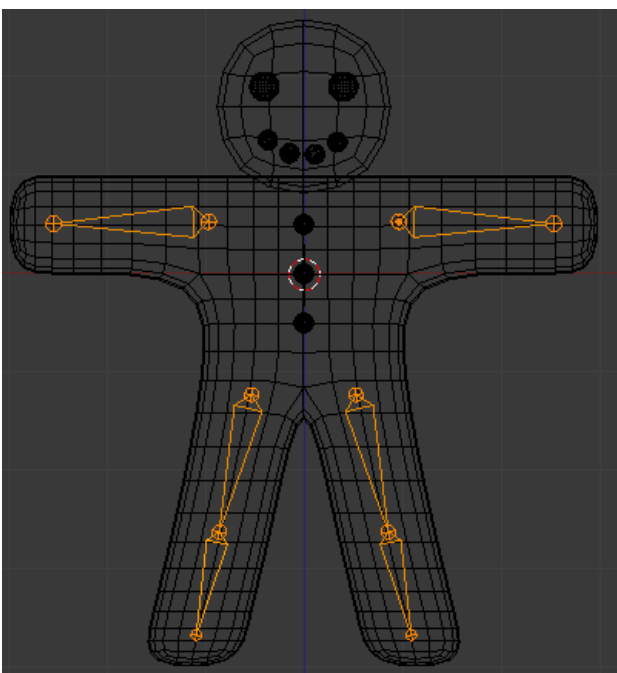
Bone position

The bones we are adding will deform Gus's body mesh. To produce a neat result, try to place the bone joints as shown in the illustrations.

Bone roll

To get the bones lined up as in (*Adding the second and third bones, a leg bone chain*) you may need to adjust the Bone Roll by pressing CtrlN, 3 with the lower leg bone selected.

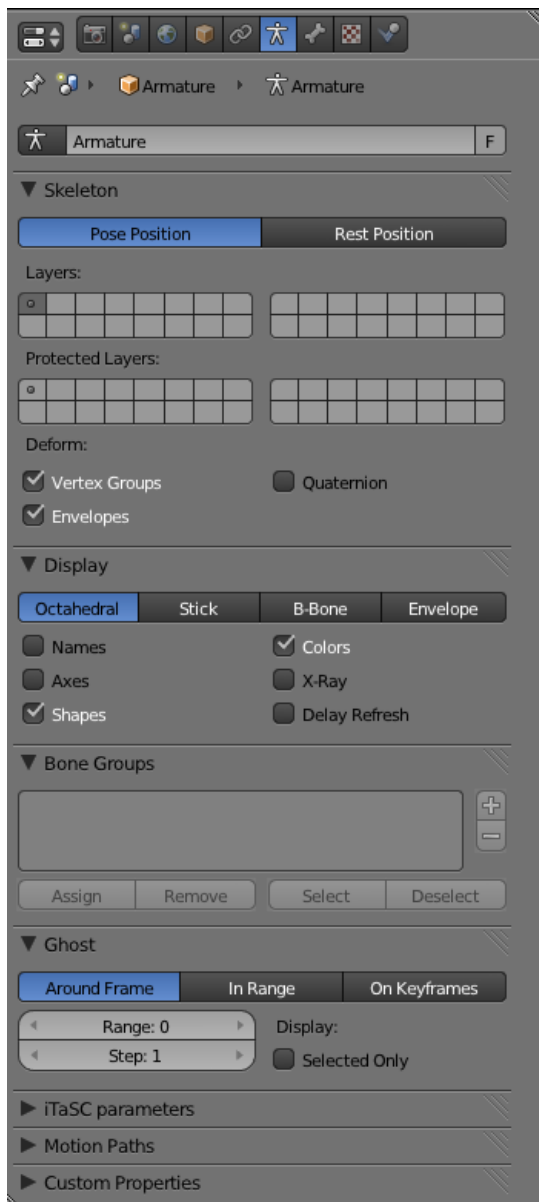
We now have three bones that make up Gus's armature.



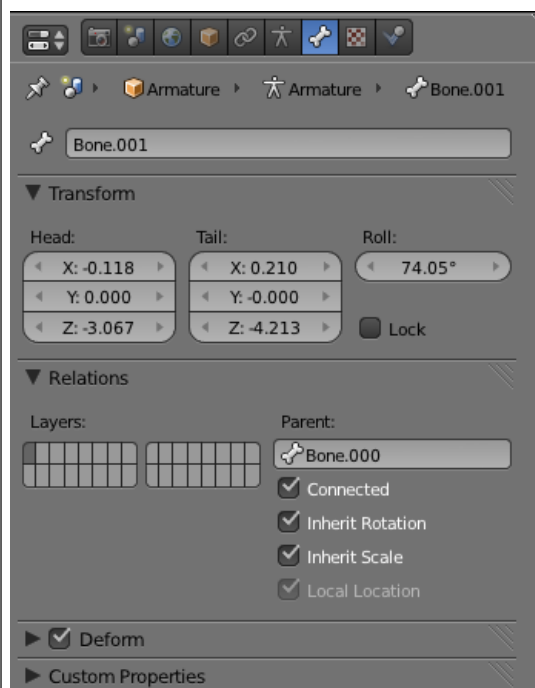
The complete armature after duplicating and flipping.

- Now place the cursor in the center (⇧ ShiftC) and select all bones with A. Duplicate them with ⇧ ShiftD and immediately exit grab mode with Esc. Make sure the cursor is selected as the rotation/scaling pivot (Pivot drop-down list in the 3D window header). Flip the duplicated bones along the X axis relative to the cursor with CtrlM and then X. Click LMB to confirm the mirror operation. You end up with (*The complete armature after duplicating and flipping*).

When any bone is selected the Object Data context shows settings for the Armature as a whole, such as the name of the Armature Object and settings for displaying the armature, while the Bone context shows the name of the active Bone and bone specific settings.



Armature context.



Armature Bones context.

Check the Names checkbox (Armature context, Display panel) to see the names of the bones in 3D views, then select each bone and LMB click on the name of the bone in the Bones context to change the bone names to something appropriate like `Arm.R`, `Arm.L`, `UpLeg.R`, `LoLeg.R`, `UpLeg.L` and `LoLeg.L`, see (*Armature Bones context*). Exit Edit mode with ⇧ Tab.

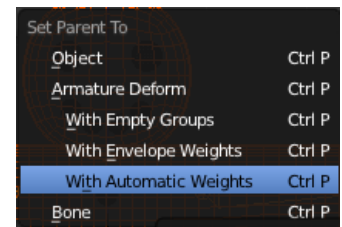
Naming Bones

It is very important to name your bones with a trailing “.L” or “.R” to distinguish between left and right ones, so that the Action Editor will be able to automatically flip your poses.

Skinning

Now we must make it such that a deformation in the armature causes a matching deformation in the body. We do this with *skinning*, which assigns vertices to bones so that the formers are subject to the latter's movements.

- In Object mode, select Gus's body, then ⇧ Shift select the armature so that the body is dark orange and the armature is light orange.
- Now we need to parent the body to the armature. That is achieved by pressing CtrlP). The (*Parenting menu*) will appear. Select the Armature Deform >> With Automatic Weights entry.

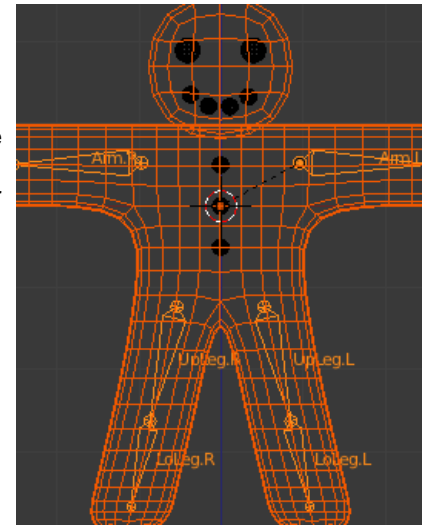


Parenting menu.

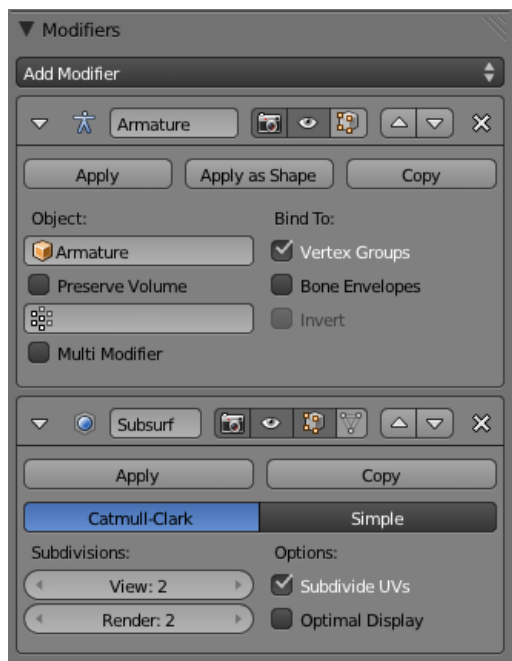
Vertex Groups, Envelopes and the order of modifiers

When skinning a mesh, the mesh object will get an Armature modifier attached to the bottom of its modifier stack. Gus' mesh already has a Subdivision Surface modifier on the stack. In order to get a smooth deformation of the mesh you should move the Armature modifier to a position above the Subdivision Surface modifier. You do this by clicking the Move Modifier buttons in the Modifier context (*The modifier stack in the Modifiers context*). Also, each bone has an area of influence called Envelope. The armature will deform the mesh from both the assigned vertex groups and the bone envelopes. This may lead to unwanted results, so in our case it is important to disable Bone Envelopes in the Armature Modifier (*The modifier stack in the Modifiers context*).

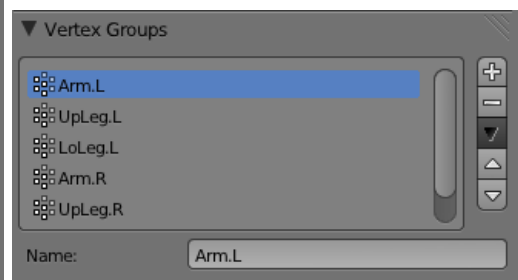
- Now select just Gus's body and switch to Edit mode (⇧ Tab). Notice in the Object Data context the presence of the Vertex Groups group of controls in the Vertex Groups panel (*The vertex groups controls in the Object Data context*).



Armature parented.

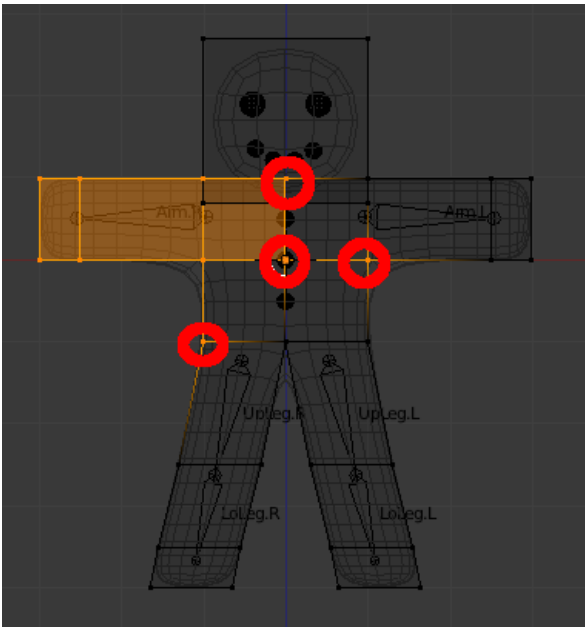


The modifier stack in the Modifiers context.



The vertex groups controls in the Object Data context.

By scrolling in the Vertex Group panel, you can see all available vertex groups – six in our case. But a truly complex character, with hands and feet completely rigged, will have tens of them! See (*The vertex groups controls in the Object Data context*). The buttons Select and Deselect (de)select all vertices of the current selected group, which allows you to see which vertices belong to which group.



Gus in Edit mode with all the vertices of group `Arm.R` selected.

Select the right arm group (`Arm.R`) and, with all vertices deselected (A, if needed), press Select. You should see something like (*Gus in Edit mode with all the vertices of group `Arm.R` selected*).

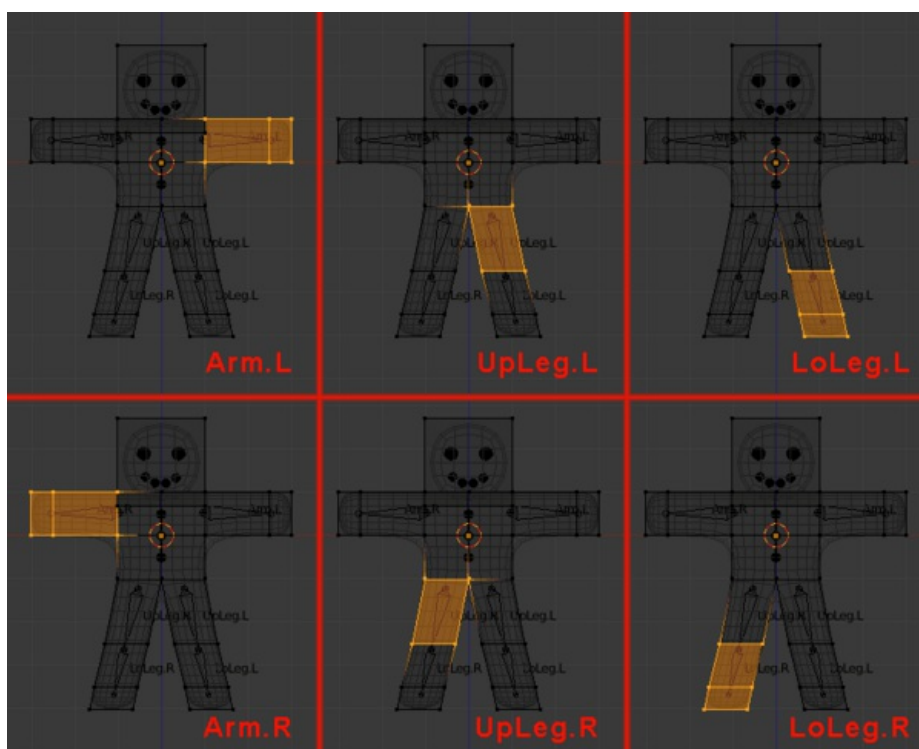
If you don't see the same thing then you probably placed the bones in just the right place such that the *auto skinning* process did a better job of matching vertices with bones. It is highly unlikely that the skinning process matched the vertices to the bones as exactly as you may expect. This requires that you begin to manually adjust the grouping as described in the following sections.

The vertices marked with red circles in (*Gus in Edit mode with all the vertices of group `Arm.R` selected*) belong to the deformation group, however, they should not.

The *auto skinning* process found that they were very close to the bone so it added them to the deformation group. We don't want them in this group since some are on the opposite side of Gus and some are in the chest, adding them to the deformation group would deform those body parts as well.

To remove them from the group, deselect all the other vertices, those which should *remain* in the group, using box selection (B), but with MMB , not LMB , to define the box, so that all vertices within the box become deselected.

Once only the "undesired" vertices are selected, press the Remove button (*The vertex groups controls in the Object Data context*), to eliminate them from the group `Arm.R`. Deselect all (A) then check another group. Check them all and be sure that they look like those in (*The six vertex groups*).



The six vertex groups.

Vertex groups

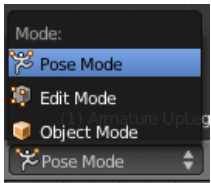
Be very careful when assigning or removing vertices from vertex groups. If later on you see unexpected deformations, you might have forgotten some vertices, or placed too many in the group. You can modify your vertex groups at any time.

Other details

Our deformations will affect only Gus's body, not his eyes, mouth, or buttons, which are separate objects. While this is not an issue to consider in this simple animation, it's one that must be taken into account for more complex projects, for example by parenting (to vertices) or otherwise joining the various parts to the body to make a single mesh (all these options are detailed in the [manual](#)).

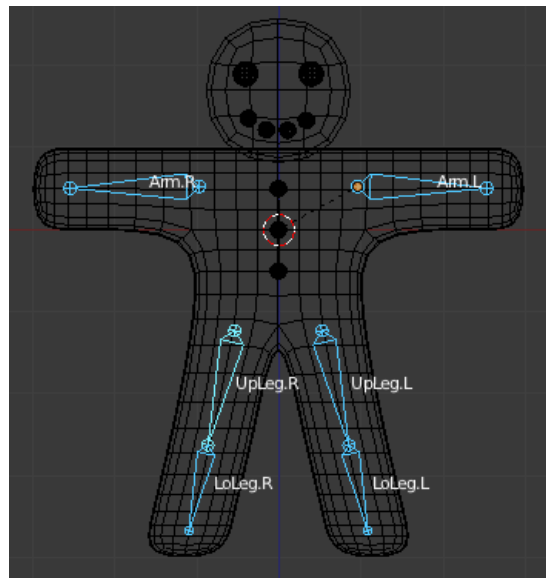
Posing

Once you have a rigged and skinned Gus you can start playing with him as if he were a doll, moving his bones and viewing the results.



Mode menu in the 3D window header.

- Select the armature only, then select Pose Mode from the Mode menu (*Mode menu in the 3D window header*) – or simply hit Ctrl+Tab. This option is only available when an armature is selected.
- The selected bones in the armature will turn blue. You are now in Pose mode. If you now select a bone, and you move it (G), or rotate it (R), the body will deform accordingly!



You are in Pose mode now!

Original position

Blender remembers the original position of the bones. You can set your armature back by pressing AltR to clear the bones' rotation, and AltG to clear their location. Alternatively, the Rest Position button in the Object Data context may be used to temporarily show the original position.

Inverse Kinematics

Inverse Kinematics (IK) is where you actually define the position of the *last* bone in the chain, often called an “*end effector*”. All the other bones assume an algorithmic position, automatically computed by the *IK solver*, to keep the chain without gaps (i.e. IK will mathematically solve the chain positions for us). This allows a much easier and precise positioning of hands and feet using IK.

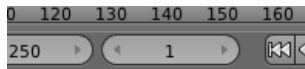
Forward Kinematics

While handling bones in Pose mode, notice that they act as rigid, inextensible bodies with spherical joints at the end. You can grab

only the first bone of a chain and all the others will follow it. All subsequent bones in the chain cannot be grabbed and moved, you can only rotate them, so that the selected bone rotates with respect to the previous bone in the chain while all the subsequent bones of the chain follow its rotation.

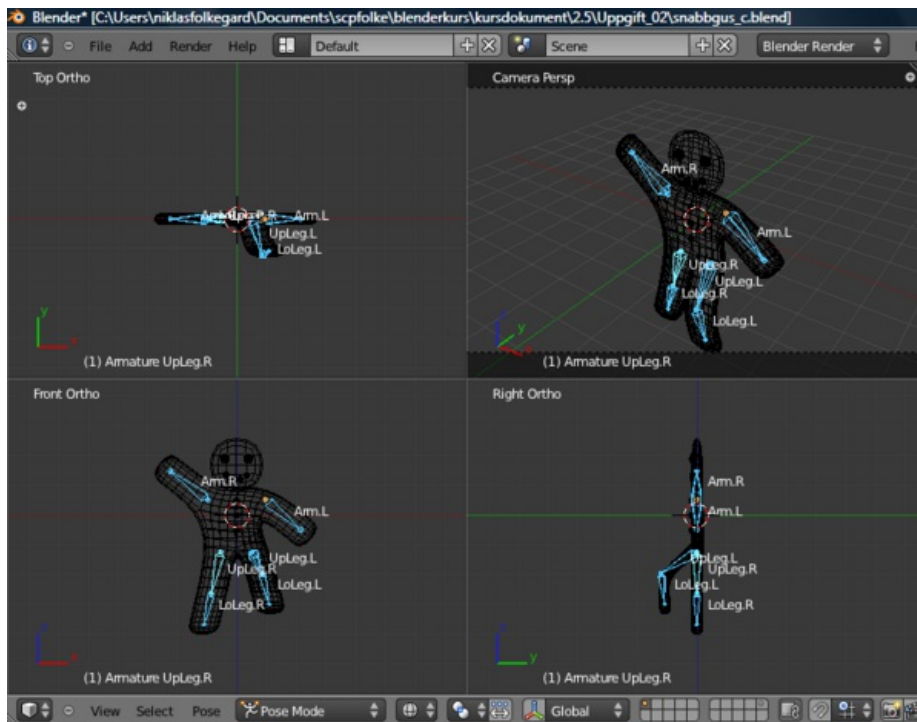
This procedure, called *Forward Kinematics* (FK), is easy to follow but it makes precise location of the last bone in the chain difficult.

We'll make Gus walk, using FK, by defining four different poses relative to four different stages of a stride. Blender will do the work of creating a fluid animation.

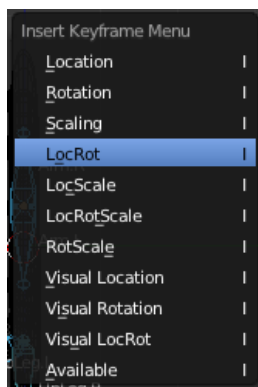


The current frame numeric field in the Timeline window header.

- First, verify that you are at frame **1** of the timeline. The frame number appears in a numeric field in the Timeline window header (*The current frame numeric field in the Timeline windowheader*). If it is not set to **1**, set it to **1** now.
- Now, by rotating only one bone at a time (R), we'll raise UpLeg.L and bend LoLeg.L backwards while raising Arm.R a little and lowering Arm.L a little, as shown in (*Our first pose*).

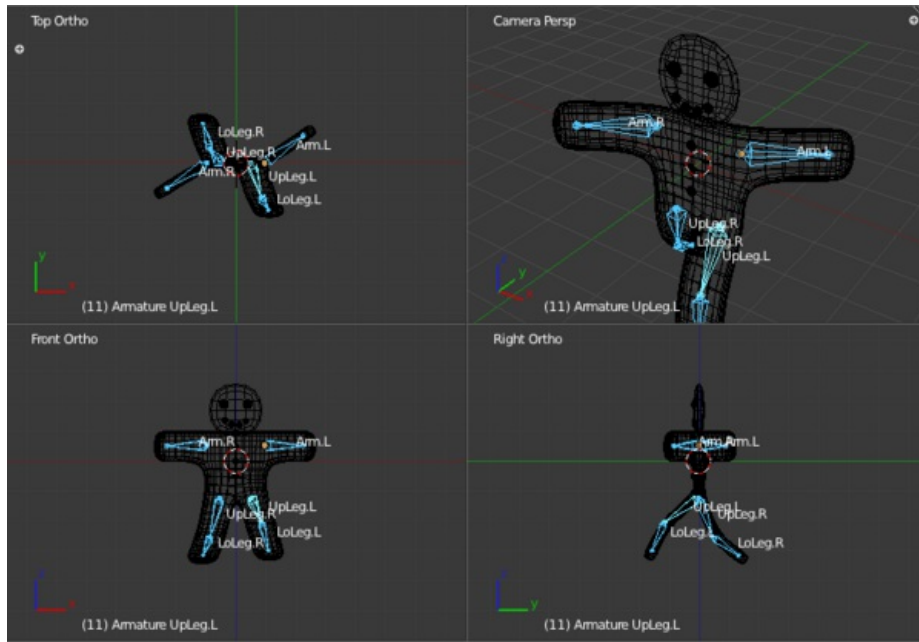


Our first pose.

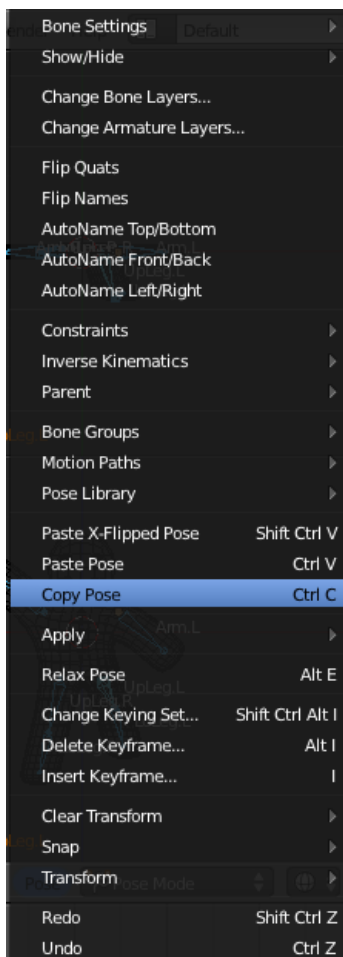


Storing the pose to the frame.

- Select all bones with A. With the mouse pointer on the 3D window, press I. A menu pops up (*Storing the pose to the frame*). Select LocRot from this menu. This will get the position and orientation of all bones and store them as a pose at frame **1**. This pose represents Gus in the middle of his stride, while moving his left leg forward and above the ground.
- Now move to frame **11** either by entering the number in the numeric field or by pressing ↑. Then move Gus to a different position, like (*Our second pose*). Start with clearing the rotation on both arms using AltR as mentioned earlier. From the top view, rotate Arm.R slightly forward and Arm.L slightly back. Finish the pose with his left leg forward and right leg backward, both slightly bent. Gus is walking in place!



Our second pose.



Pose menu.

- Select all bones again and press I to store this pose at frame **11**, and select Rot.
- We now need a third pose at frame **21**, with the right leg up, because we are in the middle of the other half of the stride. This pose is the mirror of the one we defined at frame **1**. Therefore, return to frame **1** and, with all the bones selected, in the Pose menu of the 3D window header, select the Copy Pose entry, see (*Pose menu*). Or use Ctrl+C. You have now copied the current pose to the buffer.
- Go to frame **21** and paste the pose with the Paste X-Flipped Pose option in the Pose menu, see (*Pose menu*). Or use ⇧ Shift+Ctrl+V. This will paste the cut pose, exchanging the positions of bones with suffix “.L” with those of bones with suffix “.R”, effectively flipping it!

Bone roll

If pasting an X-flipped pose makes Gus bend in the wrong direction you may have some trouble with the Bone Roll. Select all bones

in Edit Mode and press CtrlN, 3 to sort out the bone roll. Then go back to frame 1 and 11 and adjust the poses. Re-copy the pose from frame 1 and again try pasting the x-flipped pose in frame 21.

The pose is there but it has not been stored yet! You must press I » Rot with all bones selected.

- Now apply the same procedure to copy the pose at frame **11** to frame **31**, also flipping it.
- To complete the cycle, we need to copy the pose at frame **1**, *without* flipping it, to frame **41**. Do so by copying it as usual, and by using the Paste Pose entry. Or use CtrlV. End the sequence by storing the pose with I » Rot.

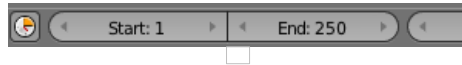
Checking the animation

To preview your animation, set the current frame to **1** and press AltA in the 3D window.

Gus walks!

The single step in-place is the core of a walk, and once you have defined one there are techniques to make a character walk along a complex path. But, for the purpose of our Quick Start, this single step in-place is enough.

- In the Render context in the Properties window, set the start frame (Start) to **1** (it should already be at **1** by default) and set the end frame (End) to **40** (it is set to **250** by default, see *Settings for an animation in the Render context*). Because frame **41** is identical to frame **1**, we only need to render frames from **1** to **40** to produce the full cycle.



Settings for an animation in the Render context.

- Type `//render/` in the text field in the Output panel.
- Select AVI Raw as the file type in the Format panel. While this is generally not the best choice, mainly for file size issues, it is fast and it will run on any machine, so it suits our needs. You could also select AVI Jpeg to produce a more compact file. However, it uses lossy JPEG compression and will produce a movie that some external players might not be able to play.

Finally, press the Animation button in the Render panel. Remember that *all* the layers that you want to use in the animation must be shown! In our case, these are layers 1 and 10.

Stopping a Rendering

If you make a mistake, like forgetting to turn layer 10 on, you can stop the rendering process with Esc.

Our scene is pretty simple, and Blender will probably render each of the forty images in a few seconds. Watch them as they appear.

Stills

Of course you can always render each of your animation frames as a still by selecting the frame you wish to render and pressing the RENDER button.

Once the rendering is complete you should have a file named `0001_0040.avi` in a `render` subdirectory of your current directory – the one containing your `.blend` file. The directory can be changed from the Output panel.

You can play this file directly within Blender by pressing Play Rendered Animation in the top menu (or by using CtrlF11). The animation will automatically cycle. To stop it press Esc. We have produced only a very basic walk cycle. There is much more in Blender, as you'll soon discover reading its whole [manual](#)!

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

File operations

The options to manage files are:

File » [Open](#)

Open a blend file

File » [Save](#)

Save the current blend file

File » Link or File » Append

You don't have to load a complete file, you can load in only selected parts from another file if you wish. See the "[Appending and Linking](#)" page.

File » Import

Blender can use information stored in a variety of other format files which are created by other graphics programs. It does this by running a [script to import the file](#).

- [COLLADA](#)

File » Export

Normally you save your work in a .blend file, but you can export some or all of your work to a format that can be processed by other graphics programs. To do so, you run an [export script](#).

Opening Files

Mode: All modes

Hotkey: F1

Menu: File » Open

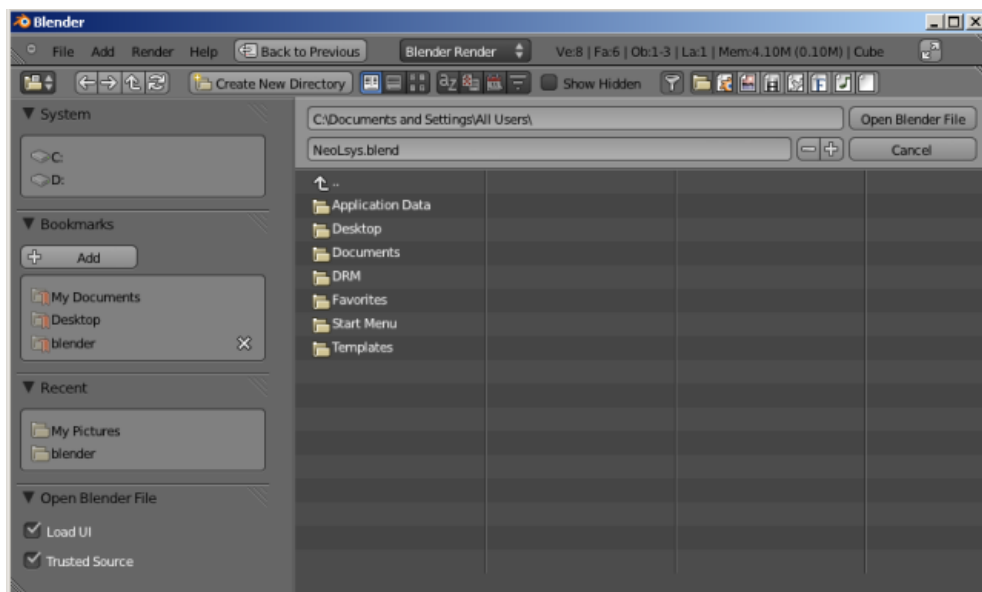
Description

Blender uses the `.blend` file format to save nearly everything: objects, scenes, textures, and even all your user interface window settings.



Blender expects that you know what you are doing! When you load a file, you are **not** asked to save unsaved changes to the scene you were previously working on, completing the file load dialog is regarded as being enough confirmation that you didn't do this by accident.

Make sure that you save your files.



Using the File Browser and Folder Navigation

To load a Blender file from disk, press F1. The File Browser window, as shown above, will open.



The upper text box displays the current directory path, and the lower text box contains the selected filename. P (or the P button) moves you up to the parent directory.

The + and - buttons allow you to cycle through numbered files by increasing or decreasing the number at the end of the file name.

Click on a folder to go inside of it, or click on a file then press the Open Blender File to open it

Clicking Cancel will close the file browser window and return to the program.

Side Panel

The panel on the left displays different ways to find files and several options. To load a file, select it with LMB  and then press ↵ Enter, or click the Open File button. A file can also be loaded by simply clicking MMB  over its name.

System

The system menu contains a list of drives that are available to navigate through to find files. Click on one to jump to that drive.

Bookmarks

These are folders that you want to be able to access often without having to navigate to them in the file browser. To add a directory to the bookmark menu, navigate to that folder, then click the Add button. To remove a folder from the list, simply click the X icon next to it.

Recent

This is a list of recently accessed folders. You can control how many folders appear in this list by going to the File tab of the user Preferences, in the box labeled Recent Files.

Open Options

Inside each .blend file, Blender saves the user interface – the screen layouts. By default, this saved UI is loaded, overriding any user defaults or current screen layouts that you have. If you want to work on the blend file using your current defaults, start a fresh Blender, then open the file browser (F1). Turn off the Load UI button, and then open the file.

The Header Panel

The Header contains several tools for navigation files. The four arrow icons allow you to:

- **Move to previous folder**
- **Move to next folder**
- **Move up to parent directory**
- **Refresh current folder**

Create a new folder inside the current one by clicking the Create New Directory icon.

The other icons allow you to control what files are visible and how they are displayed. You can:

- **Display files as a short list**
- **Display files as a detailed list**
- **Display files as thumbnails**

You can sort files:

- **Alphabetically**
- **By file type**
- **By Date of last edit**
- **By file size**

Filtering controls which file types are shown. Click the Enable Filtering icon, and toggle which types are shown:

- **Folders**
- **Blend files**
- **Images**
- **Movie files**
- **Scripts**
- **Font files**
- **Music files**
- **Text files**

Other File Open Options

From the File menu, you can also open files with the following tools:

Open Recent

Lists recently used files. Click on one to load it in.

Recover Last Session

This will load the `quit.blend` file Blender automatically saves just before exiting. So this option enables you to recover your last work session, e.g. if you closed Blender by accident...

Recover Auto Save

This will open an automatically saved file to recover it.

Security

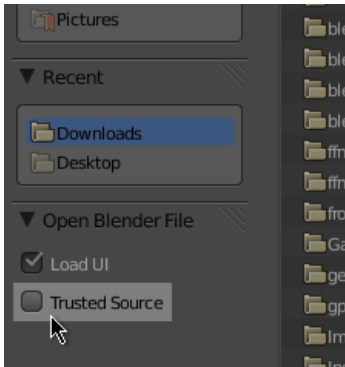
Blender is aimed at production level use and relies heavily on Python, a powerful scripting language. Python can be used in Blender to create new tools, importers and exporters, and also to drive animation rigs. With Python scripting there are endless possibilities in what you can create with Blender.

Part of Python's power comes from having full access to your system, however this power can also be misused in the wrong hands. It's possible (but not terribly likely) for dishonest people to distribute .blend files containing scripts that may damage your system. These scripts can be attached as part of animation rigs, so that they will be run when such a .blend file is opened.



Always be very careful when downloading .blend files and tools from un-trustworthy sources!

Protection



To protect against malicious .blend files, it's possible to prevent any embedded scripts from running when you open a .blend file. This will mean that custom tools or rigs using Python features will not work, but this won't be a problem for .blend files that don't use these (such as material libraries), and will at least give you a chance to better evaluate what risks might be inside.

By default, Blender will trust all files and run scripts automatically. If you don't trust the file, and want protection, you can disable 'Trusted source' in the File->Open dialog in the properties section on the bottom left. Un-trusted files will disable embedded Python scripts after opening the file.

Saving Files

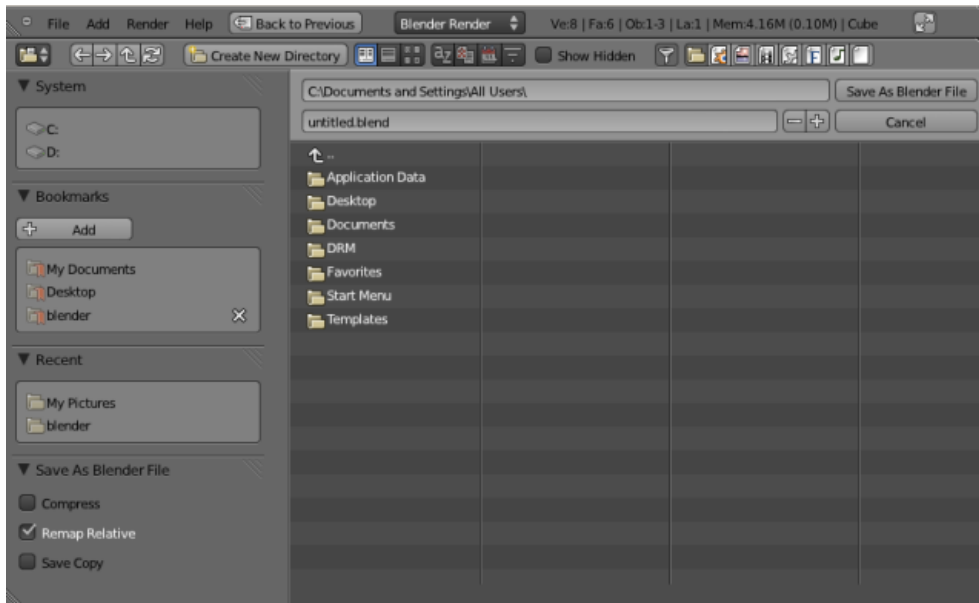
Mode: All modes

Hotkey: F2

Menu: File » Save

Description

Saving files is like loading files. When you press F2, File Browser window will open. The window appears the same as when opening files, except for a few options in the side panel. For descriptions and usage of the file browser functions, see the page on [Opening files](#).



Saving

Click the lower edit box to enter a filename. If it doesn't end with “.blend”, the extension is automatically appended. Then press `↵` Enter or click the Save File button to save the file.

If a file with the same name already exists, you will have to confirm that you want to overwrite it in the Save Over pop-up dialogue.

Depending on the number of [Save Versions](#) you have set, all existing files with the same name will be rotated to a `.blendn` file extension, where *n* is 1, 2, 3, etc. So, if you were working on `MyWork.blend`, and saved it, the existing `MyWork.blend` is renamed to `MyWork.blend1`, and a new `MyWork.blend` is saved. This way, you have hot backups of old saved versions that you can open if you need to massively undo changes.

Save Options

The save options appear at the bottom of the side panel.

Compress File

Enable this option to squash large files, this removes dead space.

Remap Relative

This option remaps relative paths when saving a file in a new location

Save Copy

This option saves a copy of the actual working state, but does not make the saved file active.

Tip for Save Increments

The save dialog contains a little feature to help you to create multiple versions of your work: pressing + NumPad or - NumPad increments or decrements a number at the end of the file name. To simply save over the currently loaded file and skip the save dialog, press CtrlW instead of F2 and just confirm at the prompt.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Data_System/Files/Import"

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COLLADA Import and Export

Page status ([reviewing guidelines](#))

Partial page

Proposed fixes: none



This page has been marked for development documentation changes.
Feel free to comment on the [talk page](#).

WIP REASON:

WIP documentation, feature still in development, [check here](#)

Mesh

Import

Supported geometry types are

- tris
- polylist
- polygons
 - ngons are reduced to Quads and Triangles automatically
- trifans
- lines

Export

Mesh data is exported as <polylist>, <lines> and <vertices>.

Light

Import

Blender does a best effort on importing lights from a .dae. If a Blender profile is detected for lights, all values from these will be used instead. This ensures 100% reimport from a Blender exported .dae. <extra> support has been added in Blender 2.57.

Export

A Blender profile for lights has been added through the <extra> tag. The entire Lamp struct from Blender will be exported through this profile, with the exception of Light curve falloff .

Material & Effect

Since Blender 2.57 some changes to export of effects have been made. Most notably <lambert> is exported if and only if specularity is 0.

Animation

- Support for Object(Mesh, Camera, Light) transform Animations. Only euler rotations, which is the default option for Objects, can be exported for now. For armature bone animations euler and quaternion rotation types are supported.
- Import and export of animations for the following parameters are supported:-
 - Light
 - Camera
 - Material Effects
- Non Skin controlling armature bone animation.
- Animations of Armatures with skin deforming bones.
- Animations of Armatures in Object mode.
- Fully rigfied Armature animations. For export of rigfied Armature animations

- Select Bake Action. (press space in 3d view and Type Bake Action)
- If you have only the deform bones selected check "only selected". This will give smaller dae. Otherwise uncheck "Only Selected".
- Check "Clear Constraints".
- Bake Action.
- Select the mesh and the deform bones. Then export to COLLADA while checking only selected option. (Selecting only the Mesh and bones is not strictly necessary. Selecting and export only selected will give smaller dae.)
- [Demonstration](#)

Nodes

On import parent transformations for <instance_node>s is properly propagated to child node instances. Blender materials are exported with the following mapping:

- phong
- blinn
- lambert

For bone nodes which are leaf nodes in the armature tree, or if a bone has more than one children a blender profile for tip with an <extra> tag, is added for those joint nodes. To correctly derive the bone->tail location on re-import.

Important things to remember

- object and datablock names are constrained to 21 characters (bytes).
- uv layer names are constrained to 32 characters (bytes).
- only armature animation on mesh, single skin controller
- no support for modifiers yet

When importing a .dae that has <instance_node>s on exporting this information is essentially lost and these nodes will be <node>s.

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Data_System/Files/Import/COLLADA"

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Proposed fixes: none

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Supported Formats

Image Formats

This is the list of image file formats supported internally by Blender:

High Dynamic Range Graphics

Blender's image input/output system transparently support regular 32 bits graphics (4 x 8 bits) or floating point images storing 128 bits per pixel (4 x 32 bits).

On reading HDR images, even when they're for example 3 x 10 bits, the pixels are always converted internally to RGBA float values. Optionally, like while displaying the image in the UV Image editor, this then gets converted to regular 32 bits for faster display.

When an image has float colors, all imaging functions in Blender default to use that. This includes the Video Sequence Editor, texture mapping, background images, and the Compositor.

For hints how to manipulate or view HDR images, please check the Curves UI page.

- [OpenEXR \(Multilayer\)](#)
- [DPX, Cineon and Radiance HDR](#)

Others Formats

Here's a list of other supported image formats:

- BMP
- DDS
- SGI IRIS (old!)
- PNG
- JPEG
- JPEG 2000
- Targa
- Targa Raw (uncompressed Targa)
- TIFF

Movie Formats

- AVI (Windows)
- AVI JPEG
- AVI Raw
- Frame Server
- H.264
- MPEG
- Ogg Theora
- QuickTime
- Xvid

Color Modes

- BW, Images get saved in 8 bits grayscale (only PNG, JPEG, TGA, TIF)
- RGB, Images are saved with RGB (color)
- RGBA, Images are saved with RGB and Alpha data (if supported)

Color Depths

- 8 bit color channels
- 12 bit color channels
- 16 bit color channels
- 32 bit color channels

Reference

- http://projects.blender.org/scm/viewvc.php/trunk/blender/source/blender/makesrna/intern/rna_scene.c?view=markup&root=bf-blender

OpenEXR

[ILM's OpenEXR](#) has become a software industry standard for HDR image files, especially because of its flexible and expandable structure.

OpenEXR files can store values in the entire floating point space, positive as well as negative numbers.

Apart from reading all OpenEXR file types, with RGBA and optional Z saved, Blender supports OpenEXR in two ways:

- [Render Output](#)
- [Multi-layer, Multi-pass, tile-based files](#)

Render Output

Available options for OpenEXR render output are:

Half

Saves images in a custom 16 bits per channel floating point format. This reduces the actual "bit depth" to 10 bits, with a 5 bits power value and 1 bit sign.

Zbuf

Save the depth information. In Blender this now is written in floats too, denoting the exact distance from the camera in "Blender unit" values.

Preview

On rendering animations (or single frames via command line), Blender saves the same image also as a JPEG, for quick preview or download.

Compression (this button is below the Image menu button, default set to "None")

- PIZ, lossless wavelet compression. Compresses images with grain well.
- ZIP, standard lossless compression using zlib
- RLE, runlength encoded, lossless, works well when scanlines have same values.
- PXR24. lossy algorithm from Pixar, converting 32 bits floats to 24 bits floats.

Multi-layer, Multi-pass, tile-based files

An OpenEXR file can hold unlimited layers and passes, stored hierarchically. This feature now is in use for the "Save Buffers" render option. This option doesn't allocate the entire final Render Result before render (which can have many layers and passes), but saves for each tile the intermediate result to a single OpenEXR file in the default Blender 'temp' directory.

When rendering is finished, after all render data has been freed, this then is read back entirely in memory.

In a next release we will make this format available as a standard render output option too, allowing to re-use it in the Compositor for example, with access to all Layers and Passes like the current RenderLayer Node. (See Render Pipeline too.)

DPX and Cineon

Cineon is Kodak's standard for film scanning, 10 bits/channel and logarithmic. DPX has been derived from Cineon as the ANSI/SMPTE industry standard. DPX supports 16 bits color/channel, linear as well as logarithmic. DPX is currently a widely adopted standard used in the film hardware/software industry.

DPX as well as Cineon only stores and converts the "visible" color range of values between 0.0 and 1.0 (as result of rendering or composite). No alpha is written.

The code has been gratefully copied from CinePaint. According to CinePaint's main developer Robin Rowe the DPX code defaults to logarithmic colorspace. We cannot find yet how to disable this, but it seems to read/write fine without visible loss.

Blender DPX files (entire Elephants Dream movie) have been succesfully imported in a Quantel IQ HD/2K finishing/grading set without problems, so for now we assume it's compliant for professional usage.

Radiance HDR

Radiance is a suite of tools for lighting simulation originally written by Greg Ward. Since Radiance had the first (and for a long time the only) HDR image format, this format is supported by many other software packages.

Radiance (.hdr) files store colors still in 8 bits per component, but with an additional (shared) 8 bits exponent value, making it 32 bits per pixel. Only RGB can be stored in these files.

Page status ([reviewing guidelines](#))

Text

wrong version

Data Select Browser not applicable/available in 2.5

Overview

http://wiki.blender.org/index.php/Doc:2.5/Manual/Data_System/Data_System#Overview

Proposed fixes: none


Overview

Each .blend file contains a database. This database contains all scenes, objects, meshes, textures, etc. that are in the file. A file can contain multiple scenes and each scene can contain multiple objects. Objects can contain multiple materials which can contain many textures. It is also possible to create links between different objects.

Mode: All Modes, Any Window


Hotkey: ⌘ ShiftF4 - Data Select Browser

To access the database, press ⌘ ShiftF4 and the window will change to a Data Select Browser window, which lists the Objects in your .blend file. To go up a level, click the breadcrumbs (.) and then you will see the overall structure of a file: Action, Armature, Brush, Camera, Curve, Group, and so on (including Objects).

LMB  selecting any datablock type, Mesh, for example, will give you a listing of the meshes used in the file, along with how many users there are for each one. For example, if you had a car mesh, and used that car mesh for six cars in a parking lot scene, the Mesh listing would show the Car and then the number 6.

Mode: Data Select Browser

Hotkey: F - Fake User

RMB  selecting certain kinds of datablocks (Materials, Images, Textures...) and pressing F will assign a “fake user” to those datablocks. With a fake user in place, Blender will keep those datablocks in the file, even if they have no “real user”. Datablocks without a user, real or fake, are not saved in the .blend file. Pressing F again toggles the fake user assignment. Performing this action is the same as clicking the F button next to material/image/... names.

Outliner and OOPS Schematic

You can easily inspect the contents of your file by using the Outliner window. This window displays the Blender data system ([fully documented here](#)). This window offers two views of the database. The Outliner view allows you to do simple operations on the objects. These operations include selecting, renaming, deleting and linking. The OOPS Schematic (Object-Oriented Programming System) view allows you to easily see how datablocks are linked. You can filter the view by using buttons found in the header.

Users (Sharing)

Many datablocks can be shared among other datablocks - re-use is encouraged. For example, suppose you have a material for one object, named “Glossy”. You can select a second object, for example, one that does not have a material yet. Instead of clicking ADD NEW for the material, click the little up-down arrow next to the ADD NEW, which brings up a list of existing materials. Select “Glossy”. Now, these two objects share the same material. You will notice a “2” next to the name of the material, indicating that there are two users (the two objects) for this material. Other common examples include:

- Sharing textures among materials.
- Sharing meshes between objects (“clones”).
- Sharing lpo curves between objects, for example to make all the lights dim together.

Fake User

Remember that Blender does not save datablocks that are not linked to anything in the *current* file. If you're building a ".blend" file to

serve as a library of things that you intend to link-to from *other* files, you'll need to make sure that they don't accidentally get deleted from the current (the library) file. Do this by giving the datablocks a "fake user," by hitting the F button next to the name of the datablock. This prevents the user count from ever becoming zero: therefore, the datablock will not be deleted. (Blender does not keep track of how many other files link to this one.)

Copying and Linking Objects Between Scenes

Sometimes you may want to link or copy objects between scenes. This is possible by first selecting objects you want to link or copy and then using the Make Links and Make Single User items found in Object menu in the 3D viewport header. Use Make Links to make links between scenes. To make a plain copy, you first make a link and then use Make Single User to make a stand-alone copy of the object in your current scene. Further information on working with scenes can be found [here](#).

Appending or Linking Across Files

The content of one .blend file is easily accessed and put into your current file by using the File → Append function (accessed at any time by ⇧ ShiftF1). To find out more about how to copy or link objects across .blend files, [click here](#).

Proxy Objects

[Proxy objects](#) allow you to make (parts of) linked data local. For example, this allows an animator to make a local “copy” of the handler bones of a character, without having the actual rig duplicated. This is especially useful for character animation setups, where you want the entire character to be loaded from an external library, but still permit the animator to work with poses and actions. Another example: you can have a modeler working on the shape (mesh) of a car and another painter working on the materials for that car. The painter cannot alter the shape of the car, but can start working with color schemes for the car. Updates made to the shape of the car are applied automatically to the painter's proxy.

Pack and Unpack Data

Blender has the ability to encapsulate (incorporate) various kinds of data within the .blend file that is normally saved outside of the .blend file. For example, an image texture that is an external .jpg file can be put “inside” the .blend file via File → External Data → Pack into .blend file. When the .blend file is saved, a copy of that .jpg file is put inside the .blend file. The .blend file can then be copied or emailed anywhere, and the image texture moves with it.

You know that an image texture is packed because you will see a little “Christmas present gift box” displayed in the header.

Unpack Data

When you have received a packed file, you can File → External Data → Unpack into Files.... You will be presented with the option to create the original directory structure or put the file in the // (directory where the .blend file is). Use “original locations” if you will be modifying the textures and re-packing and exchanging .blend files, so that when you send it back and the originator unpacks, his copies of the textures will be updated.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

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Scene Management Structure

Scene management and library appending/linking is based on Blender's [Library and Data System](#), so it is a good idea to read that manual page first if you're not familiar with the basics of that system.

Blender can be used to create something as simple as a single scene or image, or scaled up to an entire movie. A movie is usually comprised of three acts:

1. Introduction-Conflict.
2. Rising Tension.
3. Climax-Resolution.

Each act contains a few scenes, settings where the action happens. Each scene is shot on a set, stage or location. Each is set with props and backdrops. The scene is a set of action sequences where the actors act (hopefully convincingly). Each sequence, or shot, usually lasts a few seconds.

Sequence shot

Sometimes, a single shot lasts several minutes: its a "sequence shot", which might even be a complete scene on its own. Technique hard to master if you don't want your audience to fall asleep!

A single Blender file is organized and set up to be able to contain an entire movie. Each .blend file can contain multiple scenes. A scene is a bunch of objects, organized into layers. As you progress through the creative process, you use a set of window [screen layouts](#) specifically designed to help you work efficiently through the creative process: model the objects and create the props, clothe the actors and dress the set (assign materials), define the action (animation), render the video, and produce the movie. You can tailor these screen layouts, and create custom layouts, to match your working preferences.

Planning Your Timeline

Shots within a scene are accomplished by moving a camera and/or actors through the scene for a few seconds. Time in Blender is measured in frames, and typical video has 25 or 30 frames per second (fps), and film is 24 fps. For a five-second shot then, you allocate up to 150 frames for that shot ($30 \text{ fps} \times 5 \text{ seconds}$). Giving yourself some wiggle-room, shot 2 would start at frame 250 and go from there. A one-minute movie set in a single scene for North America video broadcast (NTSC standard) would have a timeline that goes up to 1800 final frames, and may be laid out over the course of 2500 frames. This timeline allows for cutting out 700 frames, picking the best 1800 frames ($30 \text{ fps} \times 60 \text{ seconds} = 1800 \text{ frames}$) less transition time.

Multiple Cameras

You can have multiple cameras in a scene, used for different shots, and select which one is active when rendering the shot.

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Current Screen Layout and Scene

Scenes are a way to organize your work. Scenes can share objects, but can, for example, differ from one another in their rendered resolution or their camera view. The current window layout and scene are shown in the User Preferences window header, usually displayed at the top of your screen:



User Preferences window header. **A)** Window type icon, **B)** Menu, **C)** Screen Layouts, **D)** Scenes, **E)** Version of Blender currently running (click the Blender icon to the left to show splash screen).

Loading the UI with “File” → “Open”

Inside each .blend file, Blender saves the user interface layout - the arrangement of screen layouts when the file is saved. By default, this saved UI is loaded, over-riding any user defaults or the current screen layout. However, you can work on a blend file using your current UI settings by ignoring the UI settings saved in the file. This is done by restarting Blender or resetting it with (File → New, or CtrlX), and opening the file browser with (File → Open..., or F1). Turn off the Load UI button in the file browser header, and then open the file. This way, Blender will not disturb your current screen layout when it loads the new file.

Working with Scenes

Select a scene to work on by clicking the up-down arrow next to the scene name. Scenes and the objects they contain are generally specific to the project you are working on. However, they too can be saved in their current state to be re-used by pressing CtrlU. They will then appear the next time Blender starts or when the user selects File → New (CtrlX).

Blender comes with one default scene, which contains a camera, a lamp, and a box.

Adding a Scene

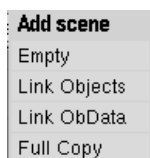
You can make a full copy of the current scene, start over with a blank slate, or create a scene that has links back to the current scene; objects will show up in the new scene, but will actually exist in the old one. Use this linking feature when, for example, the original scene contains the set, and the new scene is to contain the actors or props.

Starting Over

If you start with a new scene, be sure to add a camera and lights first!

Scenes are listed alphabetically in the drop-down list. If you want them to appear in a different order, start them with a numerical ordinal, like “1-”. The internal reference for a scene is the three-letter abbreviation “SCE”.

To add a scene, click on the scene list button, and select Add New. While you are adding a new scene, you have these options:



Add scene
popup menu.

Empty

Create a completely empty scene.

Link Objects

All objects are linked to the new scene. The layer and selection flags of the objects can be configured differently for each scene.

Link ObData


Duplicates objects only. ObData linked to the objects, e.g. mesh and curve, are not duplicated.

Full Copy

Everything is duplicated.

Usually, for your first scene, you make a full copy of the default. Alternatively, you can just start with the default, and start editing the cube that is usually hanging around waiting for you to do creative things.

Naming a Scene

By ⇧ Shift LMB -clicking on the scene name (usually “Scene.001”), you can change the name of the scene. For example, “BoyMeetsGirl” is usually the first of three acts.

You then proceed to model the props and objects in the scene using the 2-Model window layout.

Linking to a Scene

You can, at any moment, link any object from one scene to another. Just open the scene where these objects are, use CtrlL → To Scene..., and choose the scene where you want your objects to appear. Those will be linked to the original objects; to make them single user (independent, unlinked...) in a given scene go to that scene, select them and use U. You will be presented with a few options that allow you to free up the datablocks (Object, Material, Texture...) that you want.

Removing a scene from the file

You can delete the current scene by clicking the X next to the name.

Outliner window

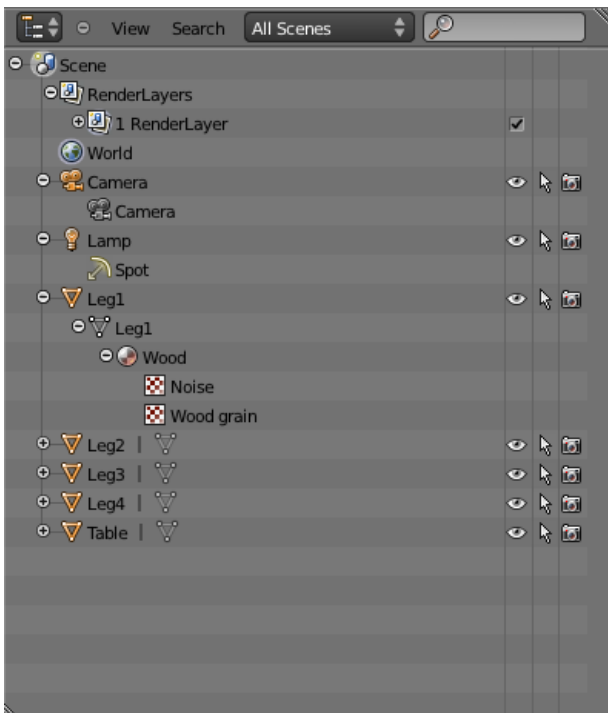
Description

The Outliner window is used for easily navigating a complex scene. The Outliner gives you a 2D representation of your complicated 3D world. Use it to find things in your scene.

For example, suppose you sneeze while moving an object; your mouse flies off your desk (gesundheit!) and the object is hurled somewhere off screen into space. Simply use the outliner to find it; select it, and move back to your 3D window to snap it back to your cursor (⇧ ShiftS → Selection → Cursor).

Another more practical example is to evaluate the impact of a change on related [datablocks](#). Suppose you are looking at your `TableTop` object, and it doesn't look right, the `Wood` material doesn't look right; you want it to look more like mahogany. Since the same material can be used by many meshes, you're not sure how many things will change color when you change the material. Using the Outliner, you could find that material and trace the links that it has to every mesh in your scene.

Outliner view

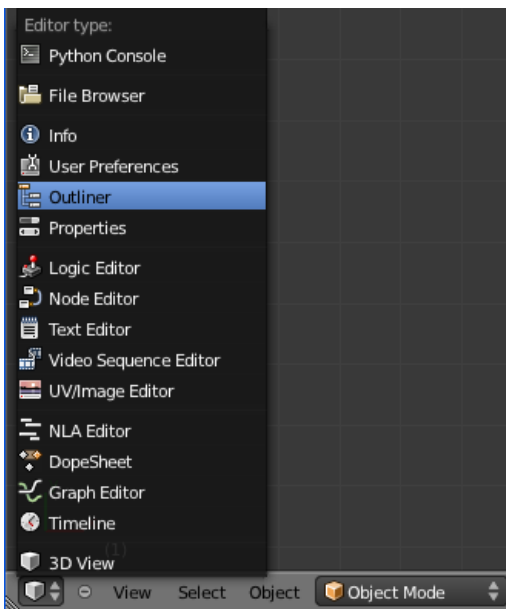


The Outliner window.



The Outliner is a kind of list that organizes things related to each other. In the outliner, you can:

- View the data in the scene.
- Select and deselect objects in the scene.
- Hide or show an object in the scene.
- Enable or disable selection (to make an object “unselectable” in the 3D Views).
- Enable or disable the rendering of an object.
- Delete objects from the scene.
- Unlink data (equivalent to pressing the X button next to the name of a datablock).
- Easily select which render layer to render.
- Easily select which render pass to render (for example, you can choose to render just the Specular pass).

Selecting the outliner window type



Change a window type to the Outliner.



Choose a window and LMB  on its current Window type button (left-most icon in its header), and LMB  on Outliner.

Using the Outliner

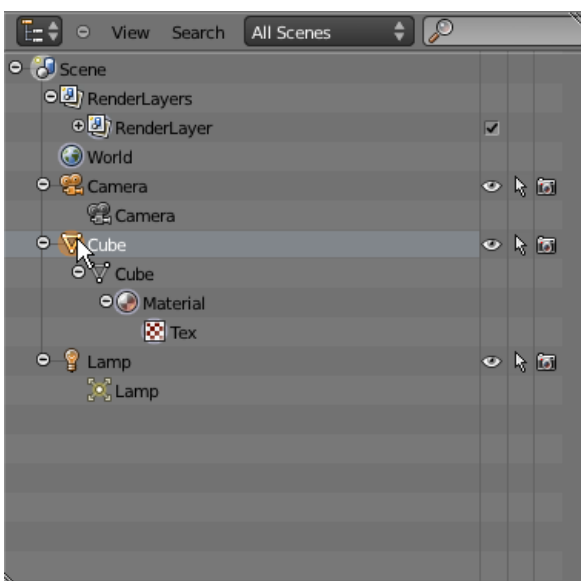
Each row in the Outliner shows a datablock. You can click the plus-sign to the left of a name to expand the current datablock and see what other datablocks it contains. If the row is already expanded, the icon to the left will be a minus-sign. Clicking the minus-sign will collapse subordinate objects beneath the row.


You can select datablocks in the Outliner, but this won't necessarily select the datablock in the scene. To select the datablock in the scene, you have to activate it.

Selecting and activating


Single selection doesn't require any pre-selection: just work directly with LMB  (and/or RMB  - contextual menu, see below) *inside* the name/icon area.

When you select an object in the list this way, it is selected and becomes the active object in all other 3D Views. Use this feature to find objects in your 3D View, select them in the Outliner, then zoom to them with `. NumPad` or if you don't have a numpad, snap and center your cursor on them via `⇧ ShiftS → Cursor → Selection`, and then `C`.

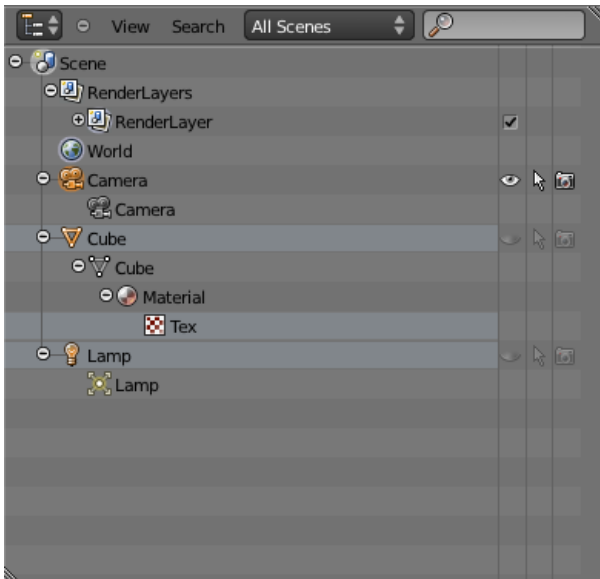


Click LMB  on the mesh data of the cube to activate Edit mode.

Activating a datablock

Activate the datablock with LMB  on the *icon* of the datablock. Activating the datablock will automatically switch to the relevant mode. For example, activating the mesh data of the cube will select the cube and enter Edit mode while activating the object







data of the cube will select the cube and enter Object mode (see right).



Toggling pre-selection of a datablock.

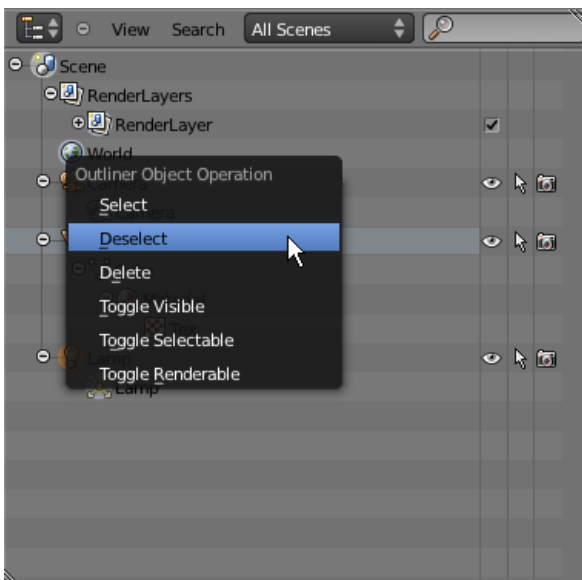
Toggle pre-selection of a group of datablocks

Useful when you want to select/deselect a whole bunch of datablocks. For this you must prepare the selection using, to your liking:

- RMB  or LMB ,
- ⇧ Shift RMB  or ⇧ Shift LMB ,
- RMB  and drag or LMB  and drag,


all *outside* the name/icon area. Those pre-selected have their line in a lighter color.

You then can (de)select them with a RMB  on the name/icon area, which brings on a context menu (see below).



Context menu for the `Cube` object.

Context menu

Show the context menu for a datablock with RMB  on the icon or name. Depending on the type of the pre-selected datablock(s), you will have all or part of the following options:

- Select.
- Deselect.
- Delete.
- Unlink – To unlink a datablock from its “owner” (e.g., a material from its mesh).
- Make Local – To create a “local” duplicate of this datablock.

Note: some datablock types will not have a context menu at all!

Deleting a datablock

Use X to delete the selected datablock(s).

Expanding one level

Use + NumPad to expand one level down in the tree-list.

Collapsing one level

Use - NumPad to collapse one level up in the tree-list.

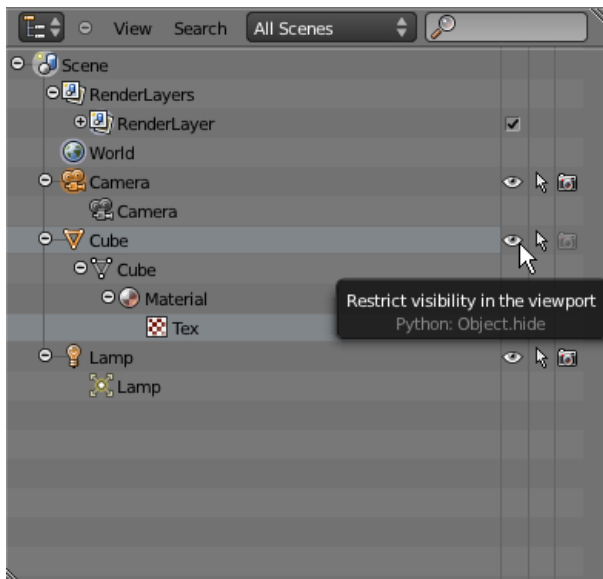
Expanding/collapsing everything

Use A to expand/collapse all levels of the tree-list.

Toggling object-level restrictions

The three following options, in the right side of the Outliner window, are only available for objects:

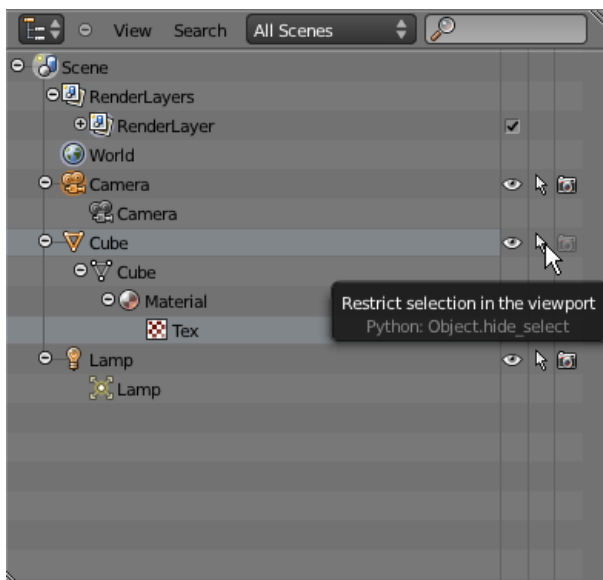
Visibility



Restrict visibility

Toggle visibility by clicking the “eye” icon for the object on the right-hand side of the Outliner. Useful for complex scenes when you don’t want to assign the object to another layer. This will only work on visible layers - an object on an invisible layer will still be invisible regardless of what the Outliner says. V will toggle this property for any objects that are pre-selected in the Outliner.

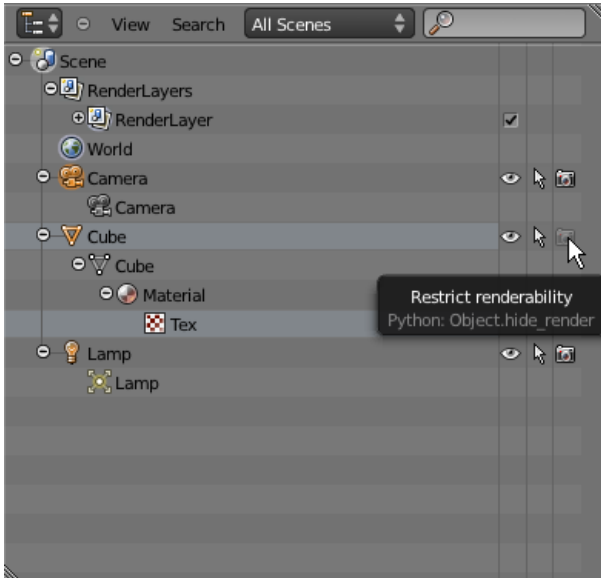
Selectability



Restrict selection

Toggle selectability by clicking the “arrow” icon. This is useful for if you have placed something in the scene and don’t want to accidentally select it when working on something else. S will toggle this property for any objects that are pre-selected in the Outliner.

Rendering



Restrict renderability

Toggle rendering by clicking the “camera” icon. This will still keep the object visible in the scene, but it will be ignored by the renderer. R will toggle this property for any objects that are pre-selected in the Outliner.

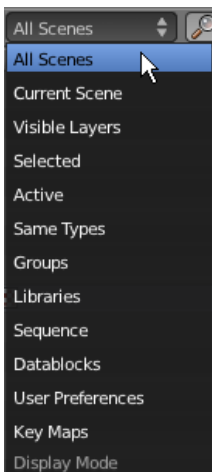
Searching

You can search the file for datablocks, either by using the Search menu in the header of the Outliner, or by using one of the following hotkeys:

- F - Find.
- CtrlF - Find (case sensitive).
- AltF - Find complete.
- CtrlAltF - Find complete (case sensitive).
- ⇧ ShiftF - Find again.

Matching datablocks will be automatically selected.


Filtering the display



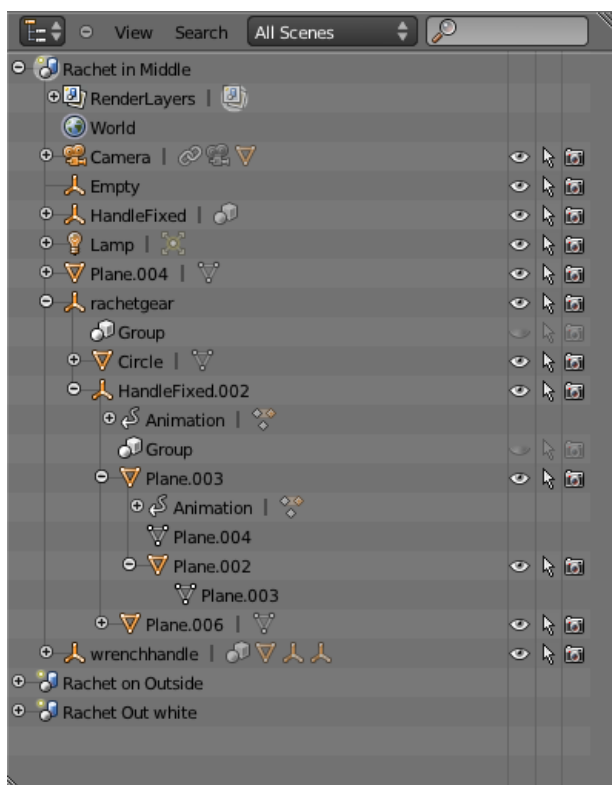
Outliner Display dropdown.

The window header has a field to let you select what the outliner should show in the outline. By default, the outliner shows All Scenes. You can select to show only the current scene, datablocks that have been selected, objects that are on currently selected layers, etc.

These selects are to help you *narrow the list* of objects so that you can find things quickly and easily.

- All Scenes - Shows *everything* the outline can display (in all scenes, all layers, etc.)
- Current Scene - Shows everything in the current scene.
- Visible Layers - Shows everything on the visible (currently selected) layers in the current scene. Use the [layers buttons](#) to make objects on a layer visible in the 3D window.
- Selected - Lists only the object(s) currently selected in the 3D window. You can select multiple objects by ⇧ Shift RMB -clicking.
- Active - Lists only the active (often last selected) object.
- Same Types - Lists only those objects in the current scene that are of the same types as those selected in the 3d window.
- Groups - Lists only [Groups](#) and their members.
- Libraries - TODO
- Sequence - TODO
- Data Blocks - TODO
- User Preferences - TODO
- Key Maps - TODO

Example



The Outliner window in list mode.

The outline example shows that the .blend file has three scenes: “Ratchet in Middle”, “Ratchet on Outside”, and “Ratchet Out White”. By clicking on the little plus-sign to the left of the name, the outline is expanded one level. This was done for the “Ratchet in Middle” scene. As you can see, this scene has some “World” material settings, a “Camera”, an “Empty”, a “HandleFixed” object... All objects that were added to the scene.

By clicking the plus-sign next to “ratchetgear”, we can see that it has some motion described by the “Animation” entry; that it was based on a “Circle” mesh, and that it is the parent of “HandleFixed.002”, which is in turn the parent of “Plane.003”, and so on.

The neat thing is: if you select any of these datablocks here, they will be selected in the 3D window as well, as far as this is possible. Pressing * NumPad with your mouse cursor in any 3D Window will center and align the view to that object. Very handy. Also, pressing X will delete it, as well as all the other hotkeys that operate on the currently selected object.

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Linked Libraries Overview

Blender is able to “reach in” to other .blend files and pull in whatever you want. In this way, Blender supports reuse of your graphical models. For example, if you have a library .blend file that has a really neat material used in it, you can, from your current .blend file, Append that material into your current .blend file. This saves you from manually re-creating all the different settings.

General Procedure

Mode: All Modes

Hotkey: ⇧ ShiftF1

Menu: File → Append or Link






The main menu in Blender is located in the User Preferences window (by default the header located at the top of your screen). From that menu, all you have to do is use File → Append or Link, or press ⇧ ShiftF1 in your active window. The active window will change to a File Browser (the Window type icon looks like a manila folder) selector window. Use this window to navigate your hard drive and network-mapped drives through folders and subfolders to find the .blend file that has the object you want to reuse. When you click on a .blend file (indicated by the orange square box next to its name), Blender will go into that file and show you the list of datablock types within it: Scenes, Objects, Materials, Textures, Meshes, etc. Clicking on any one of them will display the specific instances of that type.

Folder and File Organization

We suggest creating a folder called `/lib` or `/library`. Under that library, create a set of folders for each kind of thing you might want to access and re-use later on, such as `materials`, `textures` and `meshes`. Create subfolders under each of those as your library grows. For example, under the `meshes` folder, you might want to create folders for `people`, `spaceships`, `furniture`, `buildings`, etc. Then, when you have a .blend file that contains a chair mesh, for example, all you have to do is copy that file into the `furniture` folder.

Appending library objects into your current project

The following procedure appends an object with all its linked data, such as mesh data, materials, textures, ..., to the current .blend file.

1. Select File → Append or Link.
2. Locate and select the file that contains the object you want to append (often a “library” file).
3. Navigate to the Object section of the file.
4. Select one object from the list using LMB , multiple objects via RMB , and/or a range of objects by dragging RMB .
5. Repeat the above for each kind of object you wish to append or link. Parents and armatures (all modifier objects) must be selected separately.
6. Set desired options that are shown in the header (At Cursor, Active Layer, ...).
7. LMB  on Load Library or press ↵ Enter or MMB  directly on the data to append.


Of course, you can append or link many other things besides objects: all the ObData - cameras, curves, groups, lamps, materials, meshes, etc. - and even **an entire scene**... Note that there is a **big** difference between adding the object and the object data, such as mesh. If you append a Mesh datablock, you are only bringing in the data about that particular instance of mesh, and not an actual object instance of the mesh that you can see.

In the File Browser window header, use Append (button enabled by default) if you want to make a local independent copy of the object inside your file. Select Link if you want a dynamic link made to the source file; if anyone changes the object in the source file, your current file will be updated the next time you open it.

Click Load Library to append or link the object into your current .blend file.

Some more loading option buttons (in the File Browser header) include:

AutoSel

When an object is loaded, it is not active or selected; it just plops into your .blend file. Often, right after loading, you will want to do something with it, like scale it or move it. Enable this button and the imported object will be selected, just as if you magically RMB -clicked on it. This button saves the step of finding the object and selecting it.

Active Layer

Blender has 20 layers to divide up a large scene, and each object resides on some layer(s). By default, an object is loaded into your file directly into the layer(s) it resides on in the source file. To only load the object to the current active layer that you are

working on, enable this button.

At Cursor

By default, an object is loaded into your file at the location it is at in the source file. To reposition the object to your cursor when it loads, enable this button.



Finding What was Loaded

If the loaded object is not visible, consider using At Cursor or AutoSel. If you use AutoSel, remember there are Snap tools to put your cursor on the object (⇧ ShiftS4 (Cursor -> Selection)), and Center your view on it (C (View → Align View → Center View to Cursor)). Note that these tools do not work if the object is on an unselected layer, since objects on unselected layers are invisible.

Reusing Objects (Meshes, Curves, Cameras, Lights, ...)

Let's suppose you created a wheel in one .blend file and want to reuse it for your current project. The physical model of the wheel would be a mesh, and probably comprised of a tire and rim. Hopefully you named this mesh something reasonable, like, oh, I don't know, "Wheel". The wheel may be colored and thus have some materials assigned to it (like rubber and chrome).

Once you navigate to the file, select the "Wheel" (in the Objects datablocks) and it will be imported into your current file. You can import a copy of it, or merely link to it.



Linking

If you link to it, and later modify it in the source file, it will be shown "as-is" (modified) in your current file the next time you open it up.

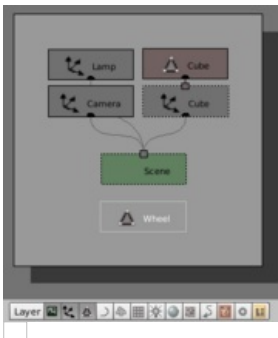
Other artists have released their models to the public domain, and friends may share models simply by posting or emailing their .blend files to each other. Keeping these files, as well as your past projects, in a [Download](#) directory on your PC/server will save you from ever having to reinvent the wheel.

When selected, linked objects are outlined in Cyan. Normal selected objects are outlined in pink.

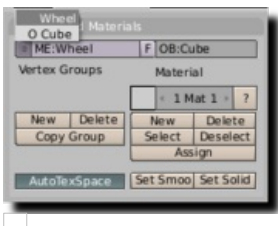
Notice that you cannot move a linked object! It resides at the same position it has in the source file. To move/scale/rotate the object, turn it into a [proxy](#).



Using Appended/Linked Mesh Data



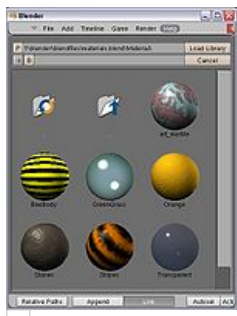
When Appending or Linking certain resources such as mesh data, it may not be instantly visible in the 3D Viewport. This is because the data has been loaded into Blender but has not been assigned to an object, which would allow it to be seen. You can verify this by looking in the Outliner window and switching it to OOPS Schematic view (you may need to have the Displays Scene datablock button selected in its header). In the OOPS Schematic picture you can see that "Wheel" is not linked to any object.



To allow the newly loaded `Wheel` mesh to be assigned to an object, either select a currently visible object or create a new object (such as a cube), then go to the Link and Materials panel and select the `Wheel` mesh from the mesh drop down panel, at that point you should see it, because it has been assigned to an object.

If instead of Appending/Linking to a mesh you instead load the object into Blender, it should be instantly displayed in the 3D Viewport without having to associate an object with the mesh (as it is already done!).

Reusing Material/Texture Settings








Material preview in Image Browser.

Some materials, like glass or chrome, can be very tricky to get “just right”. The [Blender Foundation](#) has released, for example, a [Materials CD](#), which is available for free to download from their site. Using the .blend files on that CD, you can import common materials, like glass, chrome, wood and bananas. This feature saves you a lot of time, as it often means you don’t have to be fiddling with all the little buttons and sliders just to re-create a material. I call out the Banana material because it is a great example of using simple procedural materials with a ColorRamp, and a procedural texture, to give a very realistic look. When you navigate to the file, and select Materials, the browser will show you a sphere sample of that material to help you visualize the texture that goes with the name. For more information on using the Image Browser, see [the release notes](#).

Blender Extension: Library

There is also a fantastic Python script called [Blender Library](#) that over-arches all of your files and allows you to construct a master library. This script displays a preview and helps you organize your Blender work. Highly recommended; search www.blendernation.com for “Blender Library”, it is also stored on the [Blender Wiki Scripts section](#).

Reusing Node Layouts

To reuse noodles (node layouts), open the original (source) file and create a Group for the set of nodes that you think you want to reuse. When you want to import that node group into your current file, LMB  on File → Append or LMB  on File → Link from the Info window header (or press F1 for Append or CtrlAltO for Link), and navigate to the file. When you dive into the file, there will be a NodeTree option. LMB  on it and the list of node groups in that file will be listed. LMB  on the one you want and then LMB .

[Verse]


Verse is an amazing OpenSource collaboration tool that integrates with Blender. Verse enables multiple people to work on, link, and share objects and modifications in Blender files in real time.

Proxy Objects

A proxy is a legal stand-in or substitute for the real thing. In Blender, when you make a linked copy (described above), you cannot edit the object; all you have is a link to it. You cannot add to it or change it, because its source is in another file that is not open.


When working in a team environment, you may want more flexibility. For example, if modeling a car, you may have one person working on the shape of the car (its mesh), but another working on available color schemes (its materials). In this case, you want to grant the painter a Proxy of the object and allow him/her to modify the material settings. More commonly, you will have a character being animated by a team of animators; they can define poses, but cannot change the character’s colors or armature, only use what is defined by the master rigger.

The important aspect of a proxy object is that it allows you to edit data locally, but also allows specific data to be kept restricted. Data that’s defined as restricted will always be restored from the library (typically on file reading or undo/redo steps). This restriction is defined in the referenced library itself, which means that only the library files can define what’s allowed to change locally.

For poses, you can control this by indicating bone layers as being restricted. A restricted layer is shown with a black dot in it. Use Ctrl LMB  on a button to restrict or unrestrict that layer.

Mode: Object Mode

Hotkey: CtrlAltP

To make a proxy object for yourself, establish a link to the source object as described above. With that linked copy selected (RMB ) and in view (you can see it in the 3D View), press CtrlAltP and confirm the Make Proxy dialog. The object will be named with the original name plus a “_proxy” suffix. You may now move and modify the proxy. When selected, it will look like a local object (outlined in orange).

You can then edit unrestricted data. For most objects, this includes the location and rotation. You can also animate the object's location using lpo curves. For mesh objects, the shape of the mesh is restricted, so you cannot define shape keys. When you reload your file, Blender will refresh your file with any changes made to the original restricted data, but will not reset your changes (unless the owner has).

Armatures and Multiple instances

Development of this feature is a work in progress; in Blender 2.43 and CVS (as of 29 April 2007), a proxy object controls *all instances of a group*. It is not yet possible to have one proxy per group instance. In particular, it is not yet possible to have one proxy armature per group instance. One partially effective remedy to use file append rather than file link for multiple instance duplication. File append will not be updated with update to the origination file.

If you are using a POSIX compliant file system, you can work around the one proxy object per group limitation with the cheap hack documented at [Linked Lib Animation Madness](#).

Introduction

Using Blender, you create a world that exists in four dimensions:

1. Left-right, commonly called the “x” axis.
2. Forward-backward, commonly called the “y” axis.
3. Up-down, commonly called the “z” axis.
4. Time-sensitive, through animated objects, materials, and motion captured in frames.

The problem is that you have a two-dimensional computer screen in front of you! Your mouse can only move left-right and up-down. You cannot go back in time, and you can't literally reach out into the screen and grab an object and move it somewhere else.

Instead, you have to tell Blender to do it for you. This section tells you how to navigate around in your virtual world using the unique Blender interface.

Page status ([reviewing guidelines](#))

Text

wrong place

In 2.4 this page is here Manual/3D interaction/Navigating/3D View Options

Proposed fixes: [X](#)

Introduction

The 3D View is where you perform most of the object modeling and scene creation. Blender has a wide array of tools and options to support you in efficiently working with your mouse, keyboard and keypad.

It is also the oldest, and therefore most feature- and option-rich area of Blender. However there's no need to be intimidated. Just take it slow and experiment with a few options at a time to see what they do.

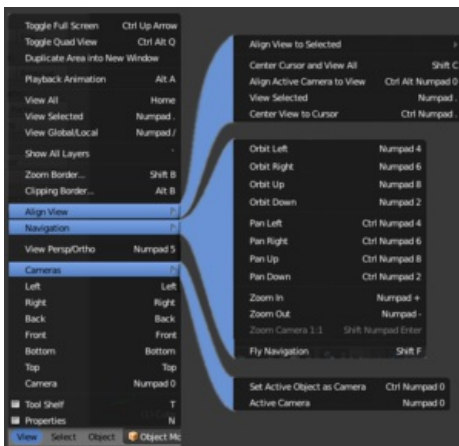
3D Window Header

The 3D View window is comprised of a workspace and a header. The header is shown at the bottom or top of the workspace, and can be hidden if desired. The header shows you a menu and the current mode, as explained below.



3D View header.

View Menu



The View menu.

Properties Panel

Toggles the Properties side panel (N), which allows you to tweak many 3D view settings:

- [Transform](#)
- [Grease Pencil](#)
- [View](#)
- [Item](#)
- [Display](#)
- [Background Images](#)
- [Transform Orientations](#)

Tool Shelf

Toggles the Tool Shelf (T), which appears on the left side of the 3d view, and allows you to perform various operations, depending on the type of object selected, and the mode you are in.

[Camera](#) (0 NumPad)

Switches the view to the current camera view.

[Viewing angles](#)

These commands change the view to the default Top/Bottom, Front/Back, or Left/Right views.

- Top (7 NumPad)
- Bottom (Ctrl7 NumPad)
- Front (1 NumPad)
- Back (Ctrl1 NumPad)
- Right (3 NumPad)
- Left (Ctrl3 NumPad)

[Cameras Menu](#)

Set Active object as camera
Active camera

[Perspective/Orthographic View](#)(5 NumPad)

These commands change the projection of the 3D view

[Navigation Menu](#)

This sub-menu contains commands for rotating and panning the view. Using these commands through the menu is not that efficient. However, like all Blender menus, the much more convenient keyboard shortcuts are listed next to the commands.

[Align View](#)

This submenu allows you to align the 3D view in certain ways.

- Align to selected
- Center cursor and view all
- Align active camera to view
- View Selected
- Center View to cursor

[Clipping Border...](#) (AltB)

Allows you to define a clipping border to limit the 3D view display to a portion of 3D space.

[Zoom Border...](#) (⇧ ShiftB)

Allows you to define the area you want to zoom into.

[Show all Layers](#) (~)

Makes all of the display layers visible.

[Global View/Local View](#) (/ NumPad)

Global view shows all of the 3D objects in the scene. Local view only displays the selected objects. This helps if there are many objects in the scene, that may be in the way. Accidentally pressing / NumPad can happen rather often if you're new to Blender, so if a bunch of the objects in your scene seem to have mysteriously vanished, try turning off local view.

[View Selected](#) (. NumPad)

Zooms the 3D view to encompass all the *selected* objects.

[Read more about Zooming the 3D View »](#)

[View All](#) (⇧ Home)

Zooms the 3D view to encompass *all* the objects in the current scene.

[Play Back Animation](#) (AltA)

Plays back the animation from the current frame.

[Duplicate area in new window](#)

Clones the current 3D view in a new window

[Quad View](#)

Toggles a four pane 3D view, each showing a different angle of the scene.

[Toggle Full Screen](#)(Ctrl↑)

Maximizes the 3D View window to fill the full screen area.

Select Menu

This menu contains tools for selecting objects.

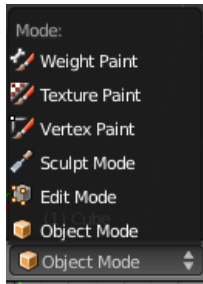
[Read more about Selecting »](#)

Object Menu

This menu appears when in Object Mode. In edit mode, it will change to the appropriate menu with editing tools.

[Read more about Objects »](#)

Mode List



The Mode drop-down list.

Blender has several modes of operation.

- Object mode allows you to work with objects as a whole.
- Edit mode by allows you to modify the shape of the object.
- [Sculpt mode](#)
 - In this mode your cursor becomes a tool to shape the object

The cursor becomes a brush in:

- [Vertex Paint](#) mode
- [Weight Paint](#) mode
- [Texture Paint](#) mode.

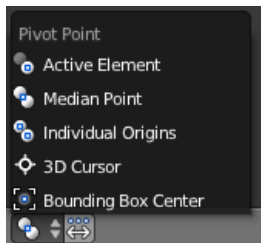
ViewPort Shading List

Allows you to change the way 3D objects are displayed in the viewport.

- Bounding Box
- Wireframe
- Solid
- Textured

[Read more about 3D view options »](#)

Pivot Point Selector



Pivot point selector.

When rotating or scaling an object or group of vertices/edges/faces, you may want to shift the pivot point (the transformation center) in 3D space. Using this selector, you can change the pivot point to the location of the:

- Active Element
- Median Point - the average center spot of the selected items
- Individual Origins
- 3D Cursor
- Bounding Box Center

Use the Object Center to switch between transforming the entire objects, or just the position of the objects

[Read more about Pivot Points »](#)

Transform (Manipulator) Selectors

These handy selectors, allow you to rotate or move objects by grabbing (clicking with your mouse) their controls and moving your mouse in the axis.

[Read more about Transform Manipulators »](#)

Layer Selector

Layers are well documented in the [Layers page](#). Toggling layer visibility is covered in the section on [viewing layers](#) and [moving objects between layers](#) is also discussed in this page.

Lock to Scene

By default, the “lock” button to the right of the layer buttons is enabled. This means that in this view, the active layers and camera are those of the whole scene (and those used at render time). Hence, all 3D views locked this way will share the same active layers and camera – when you change them in one view, all locked others will immediately reflect these changes.

But if you disable this “lock” button, you then can specify different active layers and camera, specific to this view. This might be useful if you don’t want to have your working areas (views) cluttered with the whole scene, and still have an ancillary complete view (which is unlocked with e.g. all layers shown...). Or to have several views with different active cameras. Remember that you can use (Ctrl) NumPad to make the active object the active camera.

[Read more about Scenes »](#)

Snap to Mesh

This “magnet” button controls the snapping tools that help with transforming and modeling objects.

[Read more about Snapping »](#)

Render Buttons

The Render Buttons render an OpenGL version of the 3D view.

The first button renders a still image of the Objects in the 3D view without displaying the grid, axes, etc. It uses the same Draw mode as the 3D view, so it’s rather useful if someone asks to see the wireframe of an Object you’re working on.

The second button will render an animation of the 3D View, making it useful for making preview renders of animations. The animation will be saved in the folder and format specified in the Output panel of the Render context.

Introduction

To be able to work in the three dimensional space that Blender uses, you must be able to change your viewpoint as well as the viewing direction of the scene. While we will describe the 3D View window, most of the other windows have similar functions. For example, it is possible to translate and zoom a Buttons window and its panels.



Mouse Buttons and Numpad

If you have a mouse with less than three buttons or a keyboard without numpad, please refer to the [Keyboard and Mouse](#) page of the manual to learn how to use them with Blender.

Perspective and Orthographic Views

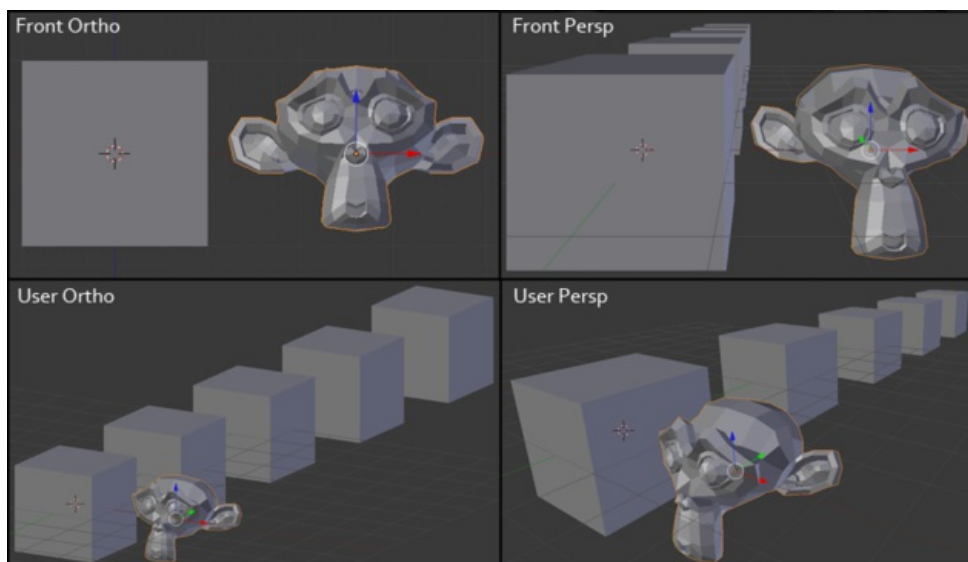
Mode: All modes

Hotkey: 5 NumPad

Menu: View » Perspective / View » Orthographic

Description

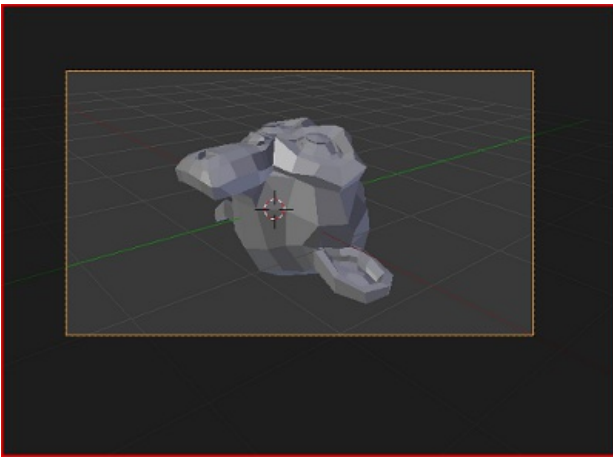
Each 3D viewport supports two different types of projection. These are demonstrated in the *Orthographic (left) and perspective (right) projections* image below.



Orthographic (left) and perspective (right) projections.

Our eye is used to perspective viewing because distant objects appear smaller. Orthographic projection often seems a bit odd at first, because objects stay the same size regardless of their distance. It is like viewing the scene from an infinitely distant point. Nevertheless, orthographic viewing is very useful (it is the default in Blender and most other 3D applications), because it provides a more “technical” insight into the scene, making it easier to draw and judge proportions.

Options



Demonstration of camera view.

To change the projection for a 3D view, choose the View » Orthographic or the View » Perspective menu entry. The 5 NumPad shortcut toggles between the two modes. Changing the projection for a 3D view does not affect the way the scene will be rendered. Rendering is in perspective by default. If you need to create an orthographic rendering, select the camera, go to the Object Data context and press the Orthographic button in the Lens panel.

The View » Camera menu entry sets the 3D view to camera mode (0 NumPad). The scene is then displayed as it will be rendered later (see *Demonstration of camera view*). The rendered image will contain everything within the orange dotted line. Zooming in and out is possible in this view, but to change the viewpoint, you have to move or rotate the camera.

If you have a large scene, viewing it through Camera View may not display all of the Objects in the scene. One possibility may be that the [clipping distance](#) of the camera is too low. The camera will only show objects that fall within the clipping range.

[Read more about Render perspectives »](#)

[Read more about Camera View »](#)

[Read more about Camera clipping »](#)

Technical Details

Perspective definition



A *perspective* view is geometrically constructed by taking a scene in 3D and placing an observer at point O . The 2D perspective scene is built by placing a plane (e.g. a sheet of paper) where the 2D scene is to be drawn in front of point O , perpendicular to the viewing direction. For each point P in the 3D scene a PO line is drawn, passing by O and P . The intersection point S between this PO line and the plane is the perspective projection of that point. By projecting all points P of the scene you get a perspective view.

Orthographic definition

In an *orthographic* projection, you have a viewing direction but not a viewing point O . The line is then drawn through point P so that it is parallel to the viewing direction. The intersection S between the line and the plane is the orthographic projection of the point P . By projecting all points P of the scene you get the orthographic view.

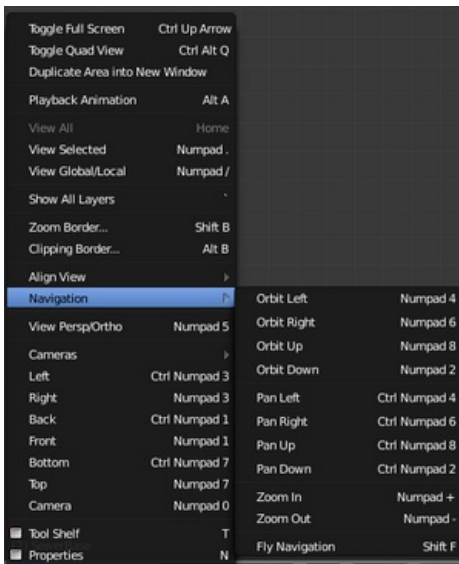
Rotating the View

Mode: All modes

Hotkey: MMB  / 2 NumPad / 4 NumPad / 6 NumPad / 8 NumPad / CtrlAlt Wheel 

Menu: View » Navigation

Description







A 3D viewport's View menu.

Blender provides four default viewing directions: Side, Front, Top and Camera view. Blender uses a right-angled “Cartesian” coordinate system with the Z axis pointing upwards. “Side” corresponds to looking along the X axis, in the negative direction, “Front” along the Y axis, and “top” along the Z axis. The Camera view shows the current scene as seen from the camera view point.

Options

You can select the viewing direction for a 3D viewport with the View menu entries, or by pressing the hotkeys 3 NumPad for “side”, 1 NumPad for “front”, 7 NumPad for “top”. You can select the opposite directions if you hold Ctrl while using the same numpad shortcuts. Finally 0 NumPad gives access to the “camera” viewpoint.

Apart from these four default directions, the view can be rotated to any angle you wish. Click and drag MMB  on the viewport's area. If you start in the middle of the window and move up and down or left and right, the view is rotated around the middle of the window. Alternatively, if the Emulate 3 button mouse option is select in the User Preferences you can press and hold Alt while dragging LMB  in the viewport's area.

To change the viewing angle in discrete steps, use 8 NumPad and 2 NumPad (which correspond to vertical MMB  dragging, from any viewpoint), or use 4 NumPad and 6 NumPad (or CtrlAlt Wheel  to rotate the scene around the Z global axis from your current point of view.

Hotkeys

Remember that most hotkeys affect **the active window** (the one that has focus), so check that the mouse cursor is in the area you want to work in before your use the hotkeys.


TrackBall/Turntable

By default, when you rotate the view as described above, you are rotating the scene as though you are rolling your hand across a “**trackball**”. For some users this is intuitive and for others it is not. If you feel you are having difficulties with this style of 3D window rotation you can switch to the “**turntable**” style.

The Turntable style is fashioned more like a record player where you have two axes of rotation available, and the world seems to have a better definition of what is “Up” and “Down” in it. The downside to using the Turntable style is that you lose some flexibility when working with your objects. However, you gain the sense of “Up” and “Down” which can help if you are feeling disoriented. Of course you can always switch between the styles depending on what you are working on.



View rotation.

To change the rotation “style”, use the [User Preferences window](#). Click on the Input button and you will see an option for choosing the Orbit style. There are two additional checkboxes for controlling the display in the 3D window in the Interface tab in the User Preferences. Auto Perspective will automatically switch to perspective whenever the view is rotated using MMB . Rotate Around Selection will rotate the view around the center of the current selection. If there is no selection at that moment (e.g. if you used A to deselect everything), the last selection will be used anyway.



Panning the View

Mode: All modes

Hotkey: ⇧ Shift MMB  / Ctrl2 NumPad / Ctrl4 NumPad / Ctrl6 NumPad / Ctrl8 NumPad / ⇧ ShiftAlt LMB 

Menu: View → Navigation

Description

To pan the view, hold down ⇧ Shift and drag MMB  in the 3D Viewport. For discrete steps, use the hotkeys Ctrl8 NumPad, Ctrl2 NumPad, Ctrl4 NumPad and Ctrl6 NumPad as with rotating (note: you can replace Ctrl by ⇧ Shift). For those without a middle mouse button, you can hold ⇧ Shift Alt while dragging with LMB .


Zooming the View



Mode: All modes

Hotkey: Ctrl MMB  / Wheel  / + NumPad / - NumPad

Menu: View → Navigation

Description

You can zoom in and out by holding down Ctrl and dragging MMB . The hotkeys are + NumPad and - NumPad. The View » Navigation sub-menu holds these functions too as well. Refer to the 3D viewport's View menu image above for more information.

If you have a wheel mouse, you can perform all of the actions in the 3D viewport that you would do with + NumPad and - NumPad by rotating the Wheel . To zoom a Buttons window, hold Ctrl MMB  and move your mouse up and down.

If You Get Lost...

If you get lost in 3D space, which is not uncommon, two hotkeys will help you: ↶ Home changes the view so that you can see all objects (View » View All menu entry), while . NumPad zooms the view to the currently selected objects when in perspective mode (View » View Selected menu entry).

Zoom Border

The Zoom Border tool allows you to specify a rectangular region and zoom in so that the region fills the 3d view.

You can access this through the View menu, or the shortcut ⇧ ShiftB then click and drag rectangle to zoom in.

Aligning the View

Align View

These options allow you to align and orient the view in different ways. They are found in the View Menu

Align View to Selected menu

These options align your view with specified local axes of the selected object or, in Edit mode, with the normal of the selected face.

Top ⇧ Shift7 NumPad

Bottom ⇧ ShiftCtrl7 NumPad

Front ⇧ Shift1 NumPad

Back ⇧ ShiftCtrl11 NumPad

Right ⇧ Shift3 NumPad

Left ⇧ ShiftCtrl3 NumPad

Center Cursor and View All (⇧ ShiftC)

moves the cursor back to the origin **and** zooms in/out so that you can see everything in your scene.

Align Active Camera to View, CtrlAlt0 NumPad

Gives your active camera the current viewpoint

View selected, . NumPad

Focuses view on currently selected object/s by centering them in the viewport, and zooming in until they fill the screen.

Center view to cursor, Ctrl. NumPad

Centers view to 3D-cursor

View Selected

See above

View All ↵ Home

Frames all the objects in the scene, so they are visible in the viewport.

Local and Global View

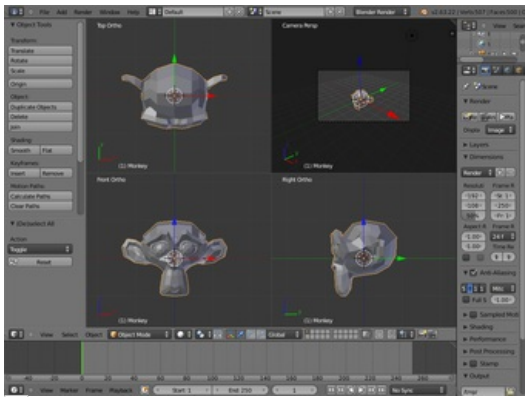
You can toggle between Local and Global view by selecting the option from the View Menu or using the shortcut / NumPad. Local view isolates the selected object or objects, so that they are the only ones visible in the viewport. This is useful for working on objects that are obscured by other ones, or have heavy geometry. Press / NumPad to return to Global View

Quad View

Mode: All modes

Hotkey: CtrlAltQ

Menu: View » Toggle Quad View



Quad View

Toggling Quad View will split the 3D window into 4 views: Top Ortho, Front Ortho, Right Ortho and Camera Perspective. This view will allow you to instantly see your model from a number of view points. In this arrangement, you can zoom and pan each view independantly but you cannot rotate the view. Note that this is different from splitting the windows and aligning the view manually. In Quad View, the four views are still part of a single 3D window. If you want to be able to rotate each view, you will need to split the 3D window into separate windows.

[Read more about splitting windows »](#)

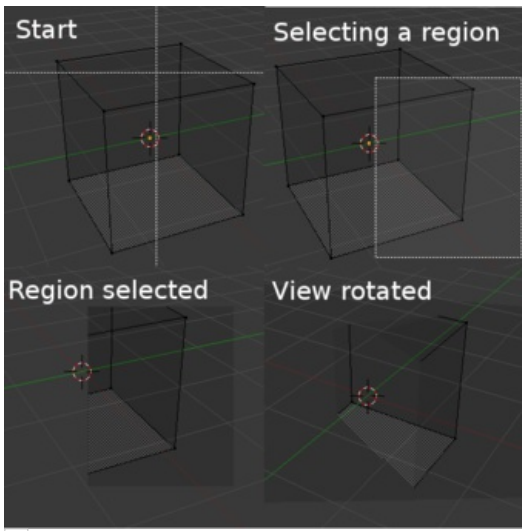
View Clipping Border

Mode: All modes

Hotkey: AltB

Menu: View » Set Clipping Border

Description



Region/Volume clipping.

To assist in the process of working with complex models and scenes, you can change the view clipping to visually isolate what you're working on.

This tool will only display what is inside a volume defined by you.

Once activated with AltB, you have to draw a rectangle with the mouse, in the wanted 3D view. The created clipping volume will then be:

- A right-angled [parallelepiped](#) (of infinite length) if your view is orthographic.
- A rectangular-based pyramid (of infinite height) if your view is in perspective.

To delete this clipping, press AltB again.

Example

The *Region/Volume clipping* image shows an example of using the clipping tool with a cube. Start by activating the tool with AltB (upper left of the image). This will generate a dashed cross-hair cursor. Click with the LMB and drag out a rectangular region shown in the upper right. Now a region is defined and clipping is applied against that region in 3D space. Notice that part of the cube is now invisible or clipped. Use the MMB to rotate the view and you will see that only what is inside the pyramidal volume is visible. All the editing tools still function as normal but only within the pyramidal clipping volume.

The dark gray area is the clipping volume itself. Once clipping is deactivated with another AltB, all of 3D space will become visible again.

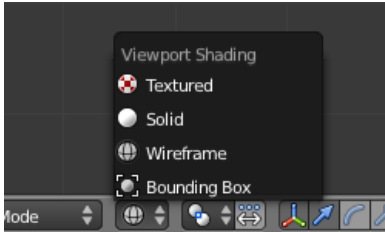
View Shading

Mode: All modes

Hotkey: Z / ⇧ ShiftZ / AltZ / ⇧ ShiftAltZ / D

Description

Depending on the speed of your computer, the complexity of your scene, and the type of work you are currently doing, you can switch between several drawing modes:



A 3D view's draw mode button.

Textured

Displays UV image textured models with OpenGL lighting. Neither procedural textures or non UV-mapped textures will be shown.

Shaded

Approximates all textures and lighting at each vertex, and blends from one to the next. Much less accurate than using the render engine to check textures, but much faster. Note that if you have no lighting in your scene, everything will remain black.

Solid

This is the default drawing mode where surfaces are drawn as solid colors, with built-in OpenGL lighting. This draw mode is not dependent on scene light sources and can be configured in the Solid OpenGL lights group of controls from the System & OpenGL tab of the User Preferences window.

[Read more about System Configuration »](#)

Wireframe

Objects only consist of lines that make their shapes recognizable (e.g. the edges of meshes or surfaces...).

Bounding Box

Objects aren't drawn at all. Instead, this mode shows only the rectangular boxes that correspond to each object's size and shape.

You can switch between these draw modes by:

- Using the Draw type drop-down list in the 3D views' header (see *A 3D view's drawmode button*).
- Pressing D to pop-up the Draw mode menu.
- Using the Z-based shortcuts as detailed below:

Draw modes and Z-based shortcuts.

Z	Switches between Wireframe and Solid draw modes.
⇧ ShiftZ	Switches between Wireframe and Shaded draw modes.
AltZ	Switches between Solid and Textured draw modes.
⇧ ShiftAltZ	Switches to the Textured draw mode.

View Properties Panel

Mode: All modes

Panel: View Properties

Menu: View » View Properties...

Description

In addition to the header controls described above, the View Properties panel lets you set other settings regarding the 3D view. You show it with the View » View Properties... menu entry.

View

Lens

Control the focal length of the 3d view camera in millimeters, unlike a [rendering camera](#)

Lock to Object

By entering the name of an object in the Object field, you lock your view to this object, i.e. it will always be at the center of the view (the only exception is the active camera view, 0 NumPad).

If the locked object is an armature, you can further center the view on one of its bones by entering its name in the Bone field.

Lock to Cursor

Lock the center of the view to the position of the 3D cursor

Lock Camera to View

When in camera view, use this option to move the camera in 3D space, while continuing to remain in camera view.

Clip Start and Clip End

Adjust the minimum and maximum distances from the 3D camera that will be visible in the viewport

Notice



A large clipping range will allow you to see both near and far objects, but reduces the depth precision



Model with no clipping artifacts.



Model with clipping artifacts.

To avoid this...

- increase the near clipping when working on large scenes.
- decrease the far clipping when objects are not viewed at a distance.

This is not specific to blender, all OpenGL/DirectX graphics applications have these same limitations.

Local Camera

Active camera used in this view

3D Cursor Location

Here you can precisely specify the position of the 3D cursor

Item

This section displays the currently selected object

Display

Only Render

Displays only items that will be rendered.

Outline Selected

If disabled, the pink outline around your selected objects in Solid/Shaded/Textured draw types will no longer be displayed.

All Object Origins

If enabled, the center dot of objects will always be visible, even for non-selected ones (by default, unselected centers might be hidden by geometry in solid/shaded/textured shadings...).

Relationship Lines

Controls whether the dashed parenting, constraining, hooking, etc., lines are drawn.

All Edges

When wire overlay is enabled in the Object context, this options forces all of the wireframe to be displayed in the viewport.

Grid Floor

If disabled, you have no grid in other views than the orthographic top/front/side ones.

X Axis, Y Axis, Z Axis

Control which axis are shown in other views than the orthographic top/front/side ones.

Lines

Controls the number of lines that make the grid in non-top/front/side orthographic views, in both directions.

Scale

Control the scale of the grid floor

Subdivisions

Controls the number of sub-lines that appear in each cell of the grid when you zoom in, so it is a setting specific to top/front/side orthographic views.

Shading

Control the way objects in the 3D view are shaded.

Textured Solid

Display face assigned textures in solid view.

Toggle Quad View

Toggles the four pane 3D view. [Read more about arranging frames »](#)

Background Image

Mode: All modes

Panel: Background Image

Menu: View » Properties...

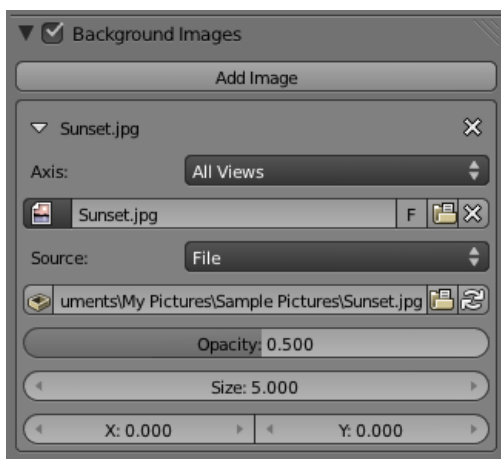
A background picture in your 3D view is very helpful in many situations: modeling is obviously one, but it is also useful when painting (e.g. you can have reference pictures of faces when painting textures directly on your model...), or animation (when using a video as background), etc.




There are a few points worth to be noted about background images:

- They are specific to their window (i.e. you can have different backgrounds for each of your 3D views, e.g. top/front/side images for relevant views...).
- *They are only available for Top, Side and Front (and their complementary versions) orthographic views!* The picture remains the same when you switch between these six views.
- Their size is related to the window's zooming factor (i.e. they grow big when you zoom in, etc.).
- You can use video files and animated sequences.


Settings



The Background Image panel.

Blender manages this feature through the Background Image menu on the view properties panel (N). The option box at the top of this panel toggles the Background Image feature on/off. By default, there is only space for one image. The settings can be accessed by LMB  the white triangle.

Once enabled, you can add an image by selecting an existing datablock, or loading a new image. The Axis menu defines which views

the image will appear in. Additional images can be added by LMB  the Add Image button. When the image is loaded, the following settings become available.

Source

Specifies what type of file is being used. Depending on the selected type, several options will appear below:

File

Use an image file

Source File

Represents the actual file that is linked to the current datablock

Sequence

a sequence of numbered image files

Frames

Set the number of image files to use in the sequence

Start

Sets the frame number to start on

Offset

Offsets the number of the frame used in the sequence

Fields

Sets the number of fields per rendered frame

Auto Refresh

Always refresh the image on frame changes

Cyclic

Cycle the images in the sequence

Movie

Use a movie file:

Match Movie Length

Set the number of frames to match the movie

Generated

Use a image generated in Blender:

Width, Height

Set the width and height if the image in pixels

Blank

Generates a blank image

UV Grid

Creates a grid for testing UV mappings

Color Grid

Creates a colored grid for testing UV mappings

Opacity

This slider controls the transparency of the background image (from **0.0** – fully opaque – to **1.0** – fully transparent).

Size

Controls the size, or scale, of the picture in the 3D view (in Blender units).

X Offset, Y Offset

The horizontal and vertical offset of the background image in the view (by default, it is centered on the origin), in Blender units.



Use Lo-Res Proxy

To improve PC performance when using background images you may have to use lower-resolution proxies. If your monitor resolution is 800×600, then the background image, full screen, without zooming, only needs to be 800×600. If your reference image is 2048×2048, then your computer is grinding away throwing away pixels. Try instead to take that 2k×2k image, and scale it down (using Blender, or Gimp) to, for example, 512×512. You will have sixteen times the performance, with no appreciable loss of quality or exactness. Then, as you refine your model, you can increase the resolution.

Shortcuts

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: deletion, redundant content.

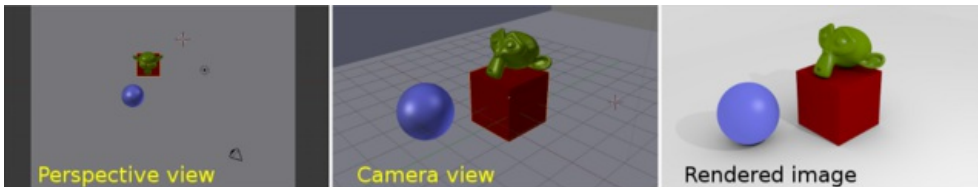
Camera View

Mode: All modes

Hotkey: 0 NumPad

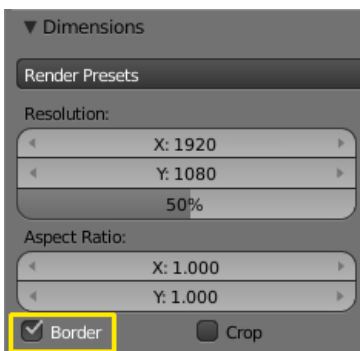
Menu: View » Camera » Active Camera

Cameras View can be used to virtually compose shots and preview how the scene will look when rendered. Pressing 0 NumPad will show the scene as viewed from the currently active camera. In this view you can also set the Render Border which defines the portion of the camera view to be rendered.



Camera view provides a preview for the final rendered image.

Render Border



Render Border toggle

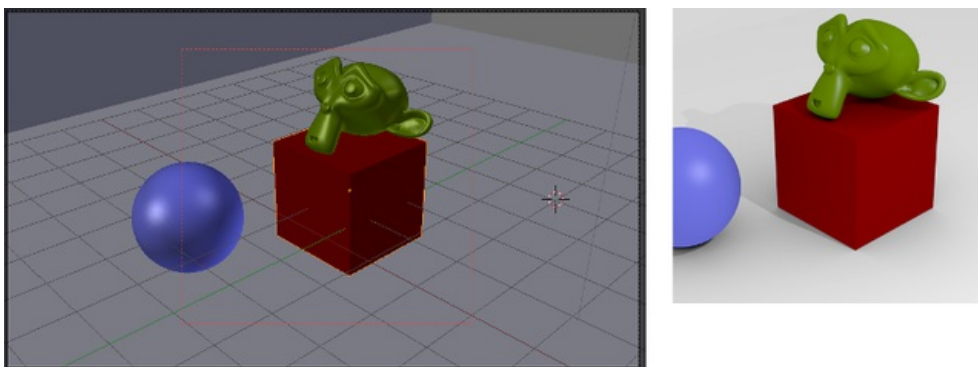
While in camera view, you can define a Render Border by pressing ⇧ ShiftB. This will allow you to draw out a dotted orange rectangle within the camera view. Your renders will now be limited to the part of scene visible within the render border. This can be very useful for reducing render times. The border can be disabled by disabling the Border option in the Dimensions panel of the Render context or by using ⇧ ShiftB to set a Render Border larger than the camera view.

Anti-Aliasing and blur options with borders

Note that when Render Borders are activated, Full Sampling Anti-Aliasing will be disabled while Sampled Motion Blur will become available.

[Read more about Anti-Aliasing »](#)

[Read more about Motion Blur »](#)



Render border and associated render.

[Read more about Render Output options »](#)

[Read more about Cameras »](#)

Layers

Mode: Object mode

Panel: Relations (Object context)

Hotkey: M

Menu: Object » Move to Layer...

3D scenes often become exponentially more confusing as they grow more complex. Sometimes the artist also needs precise control over how individual objects are lit, and does not want lights for one object to affect nearby objects. For this and other reasons below, objects can be placed into one or more “layers”. Using object layers, you can:

- Selectively display objects from certain layers in your 3D view, by selecting those layers in the 3D View header bar. This allows you to speed up interface redrawing, reduce virtual-world clutter, and help improve your workflow.
- Control [which lights illuminate an object](#), by making a light illuminate only the objects on its own layer(s).
- Control which forces affect which [particle systems](#), since particles are only affected by forces and effects on the same layer.
- Control which layers are rendered (and hence, which objects), and which properties/channels are made available for compositing by using [render layers](#).

Armatures can also become very complex, with different types of bones, controllers, solvers, custom shapes, and so on. Since armatures are usually located close together, this can quickly become cluttered. Therefore, Blender also provides layers just for armatures. Armature layers are very similar to object layers, in that you can divide up an armature (rig) across layers and only display those layers you wish to work on.

[Read more about armature layers »](#)



Working with Layers

3D layers differ from the layers you may know from 2D graphics applications as they have no influence on the drawing order and are there (except for the special functions listed above) mainly to allow you organize your scene.

When rendering, Blender only renders the selected layers. If all your lights are on a layer that is *not selected*, you won't see anything in your render except for objects lit by ambient lighting.

[Groups and Parenting](#) are other ways to logically group related sets of objects. Please refer to the relevant sections for more information.

Viewing layers

Blender provides twenty layers whose visibility can be toggled with the small unlabeled buttons in the header (see *3D Viewport layer buttons*). To select a single layer, click the appropriate button with LMB ; to select more than one, use ⇧ Shift LMB  – doing this on an already active layer will deselect it.



3D Viewport layer buttons.

To select layers via the keyboard, press 1 to 0 (on the main area of the keyboard) for layers 1 through 10 (the top row of buttons), and Alt1 to Alt0 for layers 11 through 20 (the bottom row). The ⇧ Shift key for multiple (de)selection works for these shortcuts too.

Locking to the scene

By default, the lock button directly to the right of the layer buttons is enabled. This means that changes to the viewed layers affect all other 3D Views locked to the scene – see the [navigating the 3D view options page](#) for more information.

Multiple Layers

An object can exist on multiple layers. For example, a lamp that only lights objects on a shared layer could “be” on layers 1, 2, and 3. An object on layers 3 and 4 would be lit, whereas an object on layers 4 and 5 would not. There are many places where layer-specific effects come into play, especially lights and particles.

Moving objects between layers



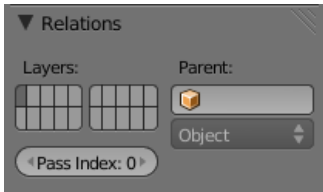
Layer selection.

To move selected objects to a different layer, press M and then select the layer you want from the pop-up dialog. Objects can also be on more than one layer at a time. To have an object on multiple layers, hold ⇧ Shift while clicking.



Object context selection.

Another way to view or change a selected object layer is via the Relations panel, in the Object context.



Layers in Object context,
Relations panel.

You will then see the layer buttons in the Relations panel – as before the object can be displayed on more than one layer by clicking ⇧ Shift LMB.

Animating Layers

An object's layer "membership" [can be animated](#). E.g. to have objects suddenly appear or disappear in a scene.

Example of object layer arrangement

As a suggestion, use the top row of layers for important parts of your scene, and the bottom row for those you don't use or change often (or for alternatives for the top row). In a staged set involving mainly two actors, you might have the following objects on your layers:

1. Lead Actors.
2. Supporting Actors.
3. Supporting Crew (background actors).
4. Particles and effects (vortex, wind).
5. Main Stage.
6. Main backdrops and panels.
7. Main props (tables, chairs).
8. Little props, fillers, decorations, trappings.
9. Cameras, Lights.
10. Lead Actors' armatures.
11. Supporting Actors' armatures.
12. Crew armatures.
13. Alternative clothing.
14. Mesh WIP.
15. Different stage setup, dimensions.
16. Different backdrops that could be used.
17. Other big props that might clog up the scene.
18. Props WIP.
19. Additional lighting.

Local or Global View

Mode: All modes

Hotkey: / NumPad

Menu: View » Local View or View » Global View

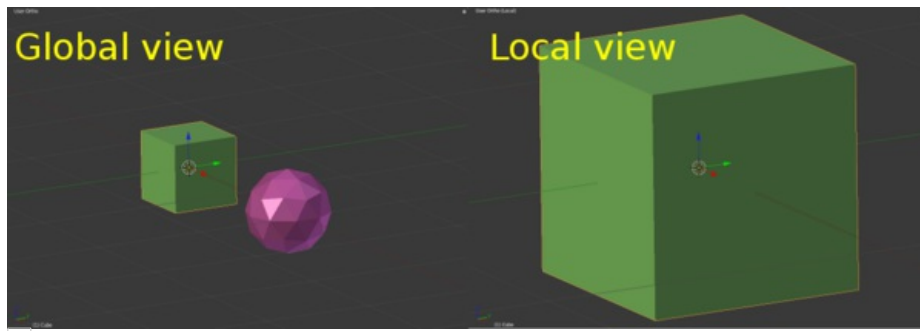
Description

When in Local view, only the selected objects are displayed, which can make editing easier in complex scenes. To enter local view, first select the objects you want, and then use the View » Local View menu entry. Use the View » Global View menu entry to go back to global view. / NumPad toggles between both views.

Note that the layer and lock buttons on the 3D View header disappear while in local view.

Examples

In *Global view*, all the objects are visible. With the green cube selected, switching to *Local view* with / NumPad will center the cube in the 3D View. If a scene has thousands of objects visible, this feature can potentially speed interactivity up because only the objects you selected will be visible.



Global and Local view

Page status ([reviewing guidelines](#))

Text

wrong
gesture isn't available

Proposed fixes: [WIP here](#)

Transformations

There are many things you can do with the selected object within your virtual world. You can twist it, make it bigger or smaller, spin it around, change its shape, and so on. This section tells you how to do these things to your objects.

Here is a list of available transformations:

- [Advanced](#)
 - [Mirror](#)
 - [Push Pull](#)
 - [Shear](#)
 - [To Sphere](#)
 - [Warp](#)
- [Basics](#)
 - [Gestures](#)
 - [Grab](#)
 - [Rotate](#)
 - [Scale](#)

You can apply transformations using:

- **shortcuts**

Tap a key to perform an action

- **context-sensitive menus**

With an object selected in a 3D view, in Object mode, the menu bar shows the View, Select and Object options. Click the Object one to manipulate the object. The menu that pops up has the option Transform. Hovering over Transform pops up a sub-menu, showing you options (and hot keys on the right) to manipulate the object.

Basic Manipulations

This section gathers all basic transformations and manipulations in 3D Views:

- [Grab \(move\) elements.](#)
- [Rotate elements.](#)
- [Scale elements.](#)
- [Snap elements to something \(geometry, grid, etc.\) during transformations.](#)
- [How to control the precision of the transformations.](#)
- [Make transformations by typing numbers rather than moving the mouse.](#)
- [Reset object's transformations.](#)

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Text no link to Transform Control

Proposed fixes: [X](#)

Grab/Move

Mode: Object and Edit modes

Hotkey: G

Menu: Object/Mesh/etc. → Transform → Grab/Move

Description

One of the fastest ways to move things in 3D space is with G. Pressing this hotkey will enter the “grab/move” transformation mode where the selected object or data is moved according to the mouse pointer’s location. The distance from the mouse pointer to the manipulated object has no effect.

Options

LMB 

Confirm the move, and leave the object or data at its current location on the screen.

MMB 

Constrain the move to the X, Y or Z axis.

RMB  or Esc

Cancel the move, and return the object or data to its original location.

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Proposed fixes: none

Rotate

Mode: Object and Edit modes

Hotkey: R



Menu: Object/Mesh/etc. → Transform → Rotate

Introduction

Rotation is also known as a spin, twist, orbit, pivot, revolve, or roll. Blender documentation will use "Rotate" or "Rot" for clarity. The four ways to rotate an object are:

1. The keyboard shortcut (**fastest- most users choose this method**)
2. (TODO) The mouse manipulator widget (easy)
3. (TODO) The properties menu. (easy)
4. (TODO) The python script (flexible and interesting)

Rotate using the keyboard shortcut

1. RMB  to select your object
2. Tap R once to enter rotation mode.
3. Rotate object by moving the mouse. The closer the mouse is to the object's center, the higher the rotation influence.
4. LMB  click to accept changes

Constraining the rotation axis

Rotate an object easily on the **X axis** by tapping R then X

Different axis can also be constrained:

R, X : Rotate along **X Axis**
R, Y : Rotate along **Y Axis**
R, Z : Rotate along **Z Axis**

To rotate along two axis and remove the third, use shift:

R, ⇧ Shift+X: Rotate along **YZ Axis**
R ⇧ Shift+Y: Rotate along **ZX Axis**
R ⇧ Shift+Z: Rotate along **XY Axis**

Fine Tuning The Rotation

Snapping

Hold Ctrl down while performing a rotation to snap the rotation to the nearest degree

Tweaking

Hold ⇧ Shift to slowly rotate to a hundredth of a degree

Trackball Rotation

Tap R,R to change rotation mode and rotate from a local perspective.

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Proposed fixes: none

Scale

Mode: Object and Edit modes

Hotkey: S

Menu: Object/Mesh/etc. → Transform → Scale

Description

Pressing S will enter the “scale” transformation mode where the selected object or data is scaled inward or outward according to the mouse pointer’s location. The object/data’s scale will increase as the mouse pointer is moved away from the pivot point, and decrease as the pointer is moved towards it. If the mouse pointer crosses from the original side of the pivot point to the opposite side, the scale will continue in the negative direction, making the object/data appear flipped. The precision of the scaling is determined by the distance from the mouse pointer to the object/data when the scaling begins.

Options

LMB 

Confirm the scale, and leave the object or data at its current scale on the screen.

MMB 

Constrain the scaling to the X, Y or Z axis.

RMB  or Esc

Cancel the scale, and return the object or data to its original scale.

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Proposed fixes: none

Mirror


Mode: Object and Edit modes

Hotkey: CtrlM

Menu: Object/Mesh/etc. → Mirror

Description

Mirroring objects flips them across an axis, determined by the [Pivot Point](#) which is essentially a scaling of -1.

Use the shortcut CtrlM, then press X, Y, or Z, to mirror on that axis. You can alternatively hold the MMB  to interactively mirror the object by moving the mouse in the direction of the mirror axis.

See the rest of the Manipulation in 3D space section for additional options available within the transformation modes.

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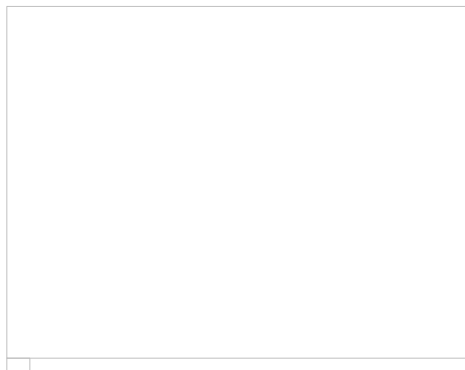
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Transform Control

In this section we explain how to control:

- the amount of change of the transformation
 - [Precision of Transformations](#)
 - [Numeric Transformations](#)
 - [Transform Properties](#)
 - [Reset Object Transforms](#)
 - [Proportional Edit](#)
- the orientation of the transformation
 - [Manipulators](#)
 - [Transform Orientations](#)
 - [Axis Locking](#)
- the center of the transformation ([Pivot Point](#))
 - [Active object](#)
 - [Individual Centers](#)
 - [3D Cursor](#)
 - [Median Point](#)
 - [Bounding Box Center](#)
- a reference object to do the transformation
 - [Snapping Transformations](#)
 - [Snap to Mesh](#)

Numeric input



Numeric input in the 3D window header

Using the mouse for transformations is convenient, but if you require more precise control, you can also enter numeric values. After pressing G, R or S, type a number to indicate the magnitude of the transformation.

You can see the numbers you enter in the bottom left hand corner of the 3D window header. Negative numbers and decimals can be entered by pressing the minus (-) and period (.) keys respectively.

Translation

To move Objects, vertices, faces or edges select the element, press G and then type a number. By default and with no other keypresses, movement will occur along the X-axis. To confirm the movement, press \leftarrow Enter or LMB . To cancel the movement, press Esc or RMB . If you mistype the value, press \leftarrow Backspace to cancel the current entry and retype a new value.

To enter numeric values for multiple axes, use the \leftrightarrow Tab key after entering a value for the axis. e.g. To move an Object, one (1) Blender unit on all three axes press: G, 1, \leftrightarrow Tab, 1, \leftrightarrow Tab, 1. This will move the element one unit along the X-axis, followed by the Y-axis and then the Z-axis.

You can also combine numeric input with axis constraints to limit movement to a particular axis. To do so, press G, X, Y or Z, 0-9, \leftarrow Enter. Pressing X, Y or Z will initially constrain movement to the Global axis. Pressing X, Y or Z again will constrain movement to the orientation set in the Transform Orientation setting of the 3D window header.

[Read more about Transform Orientations »](#)

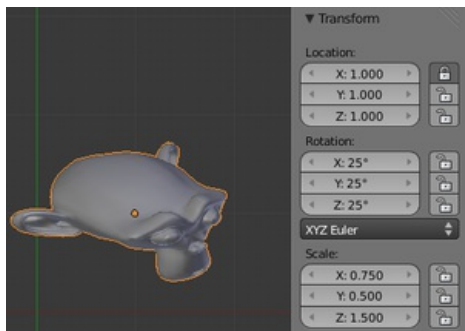
Rotation

To specify a value for clockwise rotation, press R, 0-9, then \leftarrow Enter to confirm. To specify counter-clockwise rotation press R, -, 0-9, then \leftarrow Enter to confirm. Note that 270 degrees of clockwise rotation is equivalent to -90 degrees of counter-clockwise rotation.

Scaling

Objects, faces and edges can be scaled by pressing S, 0-9, then \leftarrow Enter to confirm., Scaling transformations can also be constrained to an axis by pressing X, Y or Z after pressing S. Essentially, scaling with numeric values works in almost identical fashion to translation. The primary difference is that by default, scaling applies equally to all three axes. e.g. pressing S, 0.5, \leftarrow Enter will scale an Object by 0.5 on all three axes.

Numeric input via the Properties shelf



Transformations can also be entered through the Transform panel on the Properties shelf.

It is also possible to enter numeric values for each transformation using the Transform panel found on the Properties shelf (N). The Transform panel can also be used to prevent transformations along particular axes by clicking the lock icon.

Transform Properties

Each object stores its position, orientation, and scale values. These may need to be manipulated numerically, reset, or applied.

Transform Properties Panel

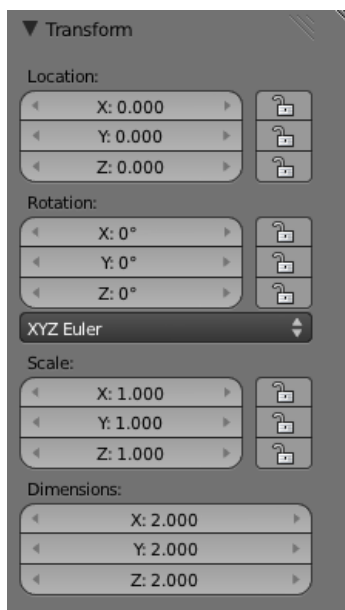
Mode: Edit and Object modes

Hotkey: N

Menu: Object » Transform Properties

The Transform Properties section in the View Properties panel allows you to view and manually/numerically control the position, rotation, and other properties of an object, in Object mode. In Edit mode, it mainly allows to enter precise coordinates for a vertex, or median position for a group of vertices (including an edge/face). As each type of object has a different set of options in its Transform Properties panel in Edit mode, see their respective descriptions in the [Modeling chapter](#).

Options in Object mode



Transform Properties panel in Object mode.

Location X, Location Y, Location Z

The object's center location in global coordinates.

Rotation X, Rotation Y, Rotation Z

The object's orientation, relative to the global axes and its own center.

Scale X, Scale Y, Scale Z

The object's scale, relative to its center, in local coordinates (i.e. the Scale X value represents the scale along the local X-axis). Each object (cube, sphere, etc.), when created, has a scale of one blender unit in each local direction. To make the object bigger or smaller, you scale it in the desired dimension.



Dimensions X, Dimensions Y, Dimensions Z

The object's basic dimensions (in blender units) from one outside edge to another, as if measured with a ruler. For multi-faceted surfaces, these fields give the dimensions of the bounding box (aligned with the local axes – think of a cardboard box just big enough to hold the object).

Use this panel to either edit or display the object's transform properties such as position, rotation and/or scaling. These fields change the object's center and then affects the aspect of all of its *vertices* and faces.



Ipo Note

The values of the location, rotation, and scale can also be affected by an Ipo keyframe, so if there are Ipo keys associated with the object, be sure to reset them after making changes in this panel, or your changes will be lost when the frame is changed (Ipo keys override manually-set properties).

Some fields have extra functionality or features, such as scroll regions. When attempting to edit these types of fields it is easier to use {⇧} LMB  instead of just LMB . After you have edited a field click outside of the field's edit area or press ↵ Enter to confirm the changes. Changes will be reflected in the display window immediately. To cancel, hit Esc. For further descriptions of the other features of an edit field see [The Interface](#) section.

Transform Properties Locking

The locking feature of the Location, Rotation and Scale fields allows you to control a transform property solely from the properties panel. Once a lock has been activated any other methods used for transformation are blocked. For example, if you locked the Location X field then you can't use the mouse to translate the object along the global X axis. However, you can still translate it using the Location X edit field. Consider the locking feature as a rigid constraint only changeable from the panel.

To lock a field, click the padlock icon next to the field. The field is unlocked if the icon appears as () , and it is locked if the icon appears as ().

Applying Transformations

Applying transform values essentially resets the values of object's position, rotation, or scale, but does not actually do anything to the object. The center point is moved to the origin and the transform values are set to zero. In terms of scale, the scale values return to 1.

To apply a transform select the Apply sub-menu from the Object menu or use the shortcut CtrlA and select the appropriate transform to apply

Make Duplicates Real unlinks linked duplicates so each duplicate now has its own datablock.

Clearing Transformations

Clearing transforms simply resets the transform values. The objects location and rotation values return to 0, and the scale returns to 1.

- Clear Transform AltG
- Clear Rotation AltR
- Clear Scale AltS
- Clear Origin AltO

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Manipulators

Mode: Object and Edit modes

Hotkey: CtrlSpace

In combination with [axis locking](#), the normal Transform commands (G for Grab, R for Rotation, S for Scale), can be used to manipulate objects along any axis. However, there may be times when these options are not adequate. For example, when you want to translate a single face on a randomly rotated object in a direction perpendicular to the face's normal. In instances like this, Transform Manipulators may be useful.



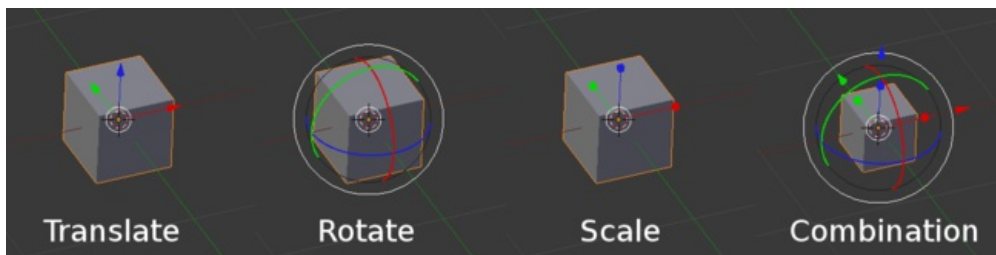
Manipulator options in the Window Header.

Transform manipulators provide a visual representation of the transform options and allow movement, rotation and scaling along any axis, mode and orientation of the 3D view. The manipulator can be enabled by clicking on the axis icon from the manipulator options portion of the window header or via the shortcut key CtrlSpace.

There is a separate manipulator for each Transform Command. Each manipulator can be used separately or in combination with the others. Clicking with ⇧ Shift LMB on multiple manipulator icons (arrow, arc, box) will combine manipulator options.

Manipulators can be accessed in the header of the 3D View window:

- Axis: Enable/disable the manipulators.
- Arrow: Translation.
- Arc: Rotation.
- Box: Scale.
- Transform Orientation menu: choice of the transformation orientation.



Manipulator Options

Manipulator controls

- Holding down Ctrl constrains the action to a set increments. Holding down ⇧ Shift **after** you LMB the manipulator handle will constrain the action to smaller increments.
- Holding down ⇧ Shift **before** you LMB click on one of the handles will cause the manipulator action to be performed relative to the other two axes (you can let go of ⇧ Shift once you have clicked). For example, if you ⇧ Shift then LMB the Z axis handle of the translate manipulator, movement will occur in the X and Y planes.
- When in rotate mode, LMB on the white circle (largest circle around the rotation manipulator) will be equivalent to pressing R.
- When in rotate mode, LMB on the grey circle (small inner circle at the center of the rotation manipulator) will be equivalent to pressing R twice. This will start trackball rotation.

[Read more about constraining transformations »](#)

[Read more about axis locking »](#)

[Read more about trackball rotation »](#)

Manipulator Preferences



Manipulator preferences.

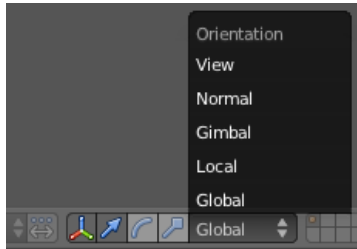
The settings of the manipulator (e.g. its size) can be found in the Interface section of the User Preferences window.

- Size: Diameter of manipulator, in 10 pixel units.
- Handle Size: Size of manipulator handles, as a percentage of manipulator radius (Size/2).
- Hotspot: Hotspot size (in pixels) for clicking manipulator handles.

Choosing the Transform Orientation

Mode: Object and Edit modes

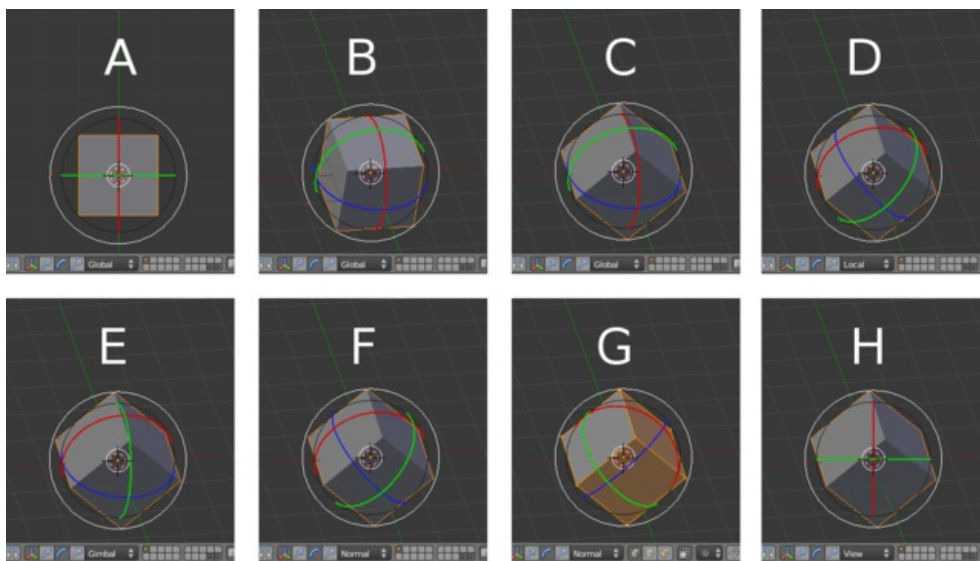
Hotkey: AltSpace



Transform Orientation options.

You can also change the [orientation of the Transform Manipulator](#) to global, local, gimbal, normal or view from the Transform options menu. The image below shows a cube with the rotation manipulator active in multiple transform orientations. Notice how the manipulator changes depending on the orientation selected (compare A with F).

Similarly, notice how when normal orientation (F and G) is selected the manipulator changes between Object mode and Edit mode. The normal orientation manipulator will also change depending on what is selected in Edit mode i.e. the orientation is based on the normal of the selection which will change depending on how many and which faces, edges or vertices are selected.



Transform manipulator orientation options.

- A: Standard cube in default top view with *global* orientation selected
- B: Standard cube with view rotated and *global* orientation selected
- C: Randomly rotated cube with view rotated and *global* orientation selected
- D: Randomly rotated cube with *local* orientation selected
- E: Randomly rotated cube with *gimbal* orientation selected
- F: Randomly rotated cube with *normal* orientation selected
- G: Randomly rotated cube, vertices selected with *normal* orientation selected
- H: Randomly rotated cube with *view* orientation selected

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Transform Orientations

Mode: Object and Edit modes

Hotkey: AltSpace

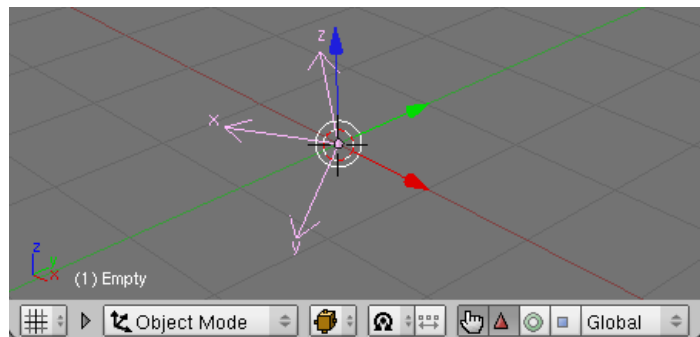


Transform orientations selection menu.

A secondary orientation can be selected with AltSpace or through the Orientation menu in a 3D view header. This orientation can then be used as a transformation constraint (like [axis locking](#)).

Options

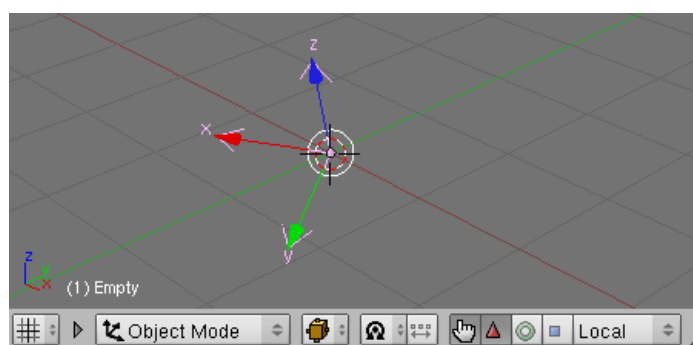
Below is a list of different transform orientation types. On every image, compare the position of the manipulator axes (color axes over the object), which materializes the transform orientation, with the global (lower left corner of the 3D window) and local (the object is an empty, so just the local axes of the object are shown) ones.



Global.

Global

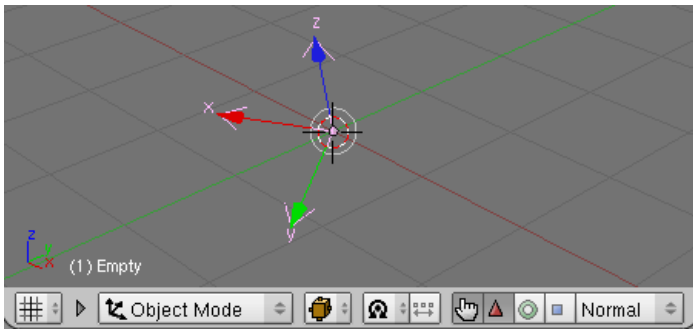
The manipulator matches the global axis.



Local.

Local

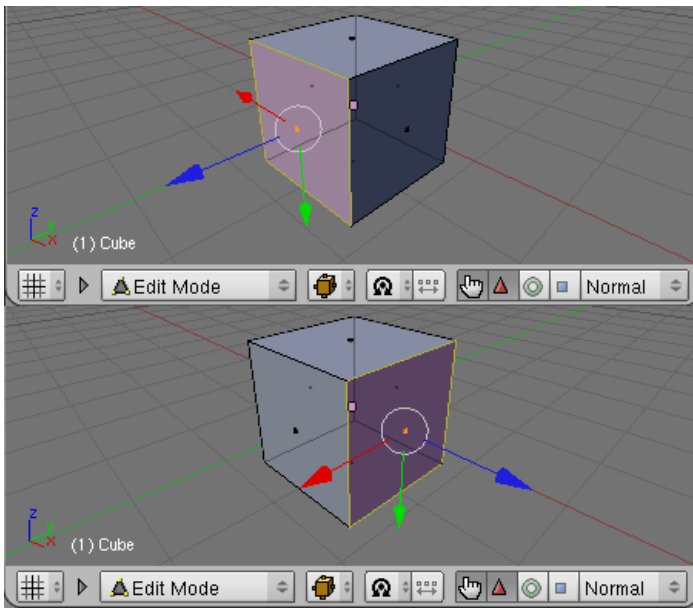
The manipulator matches the object axis.



Normal.

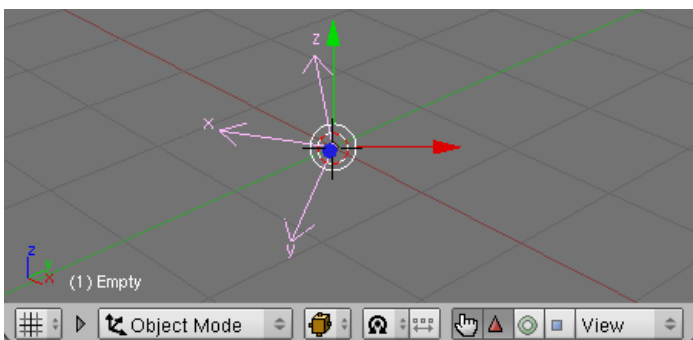
Normal

The Z axis of the manipulator will match the normal vector of the selected object. Not very useful for the empty, see the example below.



Cube example.

A better example using an object with face normals, selecting faces in Edit mode.



View.

View

The manipulator will match the 3D view, Y → Up/Down, X → Left/Right, Z → Towards/Away from you.

Custom Orientations

Mode: Object and Edit modes

Hotkey: \diamond ShiftCtrlC

You can define custom transform orientations, using object or mesh elements. Custom transform orientations defined from objects use

the local orientation of the object whereas those defined from selected mesh elements (vertices, edges, faces) use the normal orientation of the selection.

A name also needs to be assigned to the new orientation.

Note

When adding new orientations, if the name correspond to an already existing custom orientation, the new orientation will replace the old one.

Transform Orientations Panel

The Transform Orientations panel, found in the View Properties Panel, can be used to manage transform orientations: selecting the active orientation, adding and removing custom orientations and clearing all custom orientations.



Transform Orientations panel.

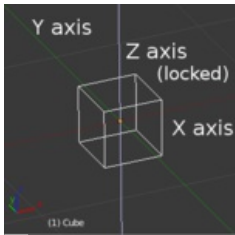


Selecting a custom orientation.



Transform Orientations panel with custom orientation selected.

Axis Locking



Axis locking

[Transformations \(translation/scale/rotation\)](#) in Object and Edit mode, as well as extrusion in Edit mode) can be locked to particular axis relative to the current [transform orientation](#). By locking a transformation to a particular axis you are restricting transformations to a single dimension.

A locked axis will display in a brighter color than an unlocked axis. For example in the image to the right, the Z axis is drawn in light blue as movement is constrained to this axis. This example was achieved by pressing G to enable translation, followed by pressing Z to constrain movement to the Z-axis.

Axis locking types

Axis locking

Mode: Object and Edit modes (translate, rotate, scale, extrude)

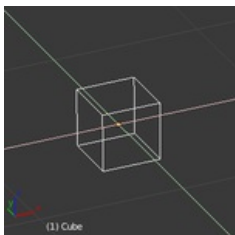
Hotkey: X, Y, Z

Axis locking limits the transformation to a single axis (or forbids transformations along two axes). An object, face, vertex or other selectable item will only be able to move, scale or rotate in a single dimension.

Plane locking

Mode: Object and Edit modes (translate, scale)

Hotkey: ⇧ ShiftX, ⇧ ShiftY, ⇧ ShiftZ

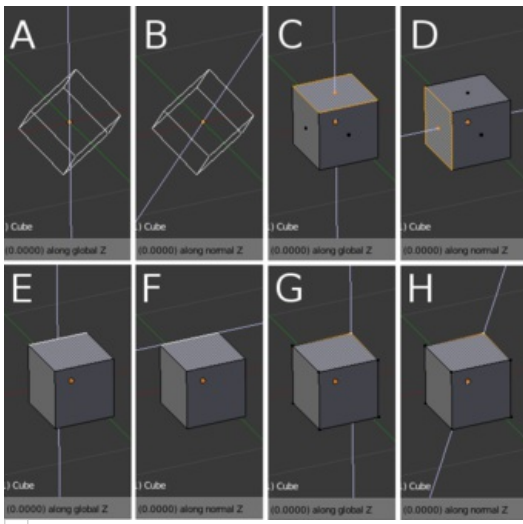


Plane locking

Plane locking locks the transformation to *two* axes (or forbids transformations along one axis), thus creating a plane in which the element can be moved or scaled freely. Plane locking only affects translation and scaling.

Note that for rotation, both axis and plane locking have the same effect because a rotation is always constrained around one axis. Trackball type rotations RR cannot be locked at all.

Axis locking modes



Axis locking modes

A single key press constrains movement to the corresponding Global axis. A second keypress of the *same* key constrains movement to the current transform orientation selection (except if it is set to Global, in which case the Local orientation is used). Finally, a third keypress of the same key removes constraints.

For example, if the current transform orientation is set to Normal, pressing G to start translation, followed by Z will lock translation in the Z direction relative to the Global orientation, pressing Z again will lock translation to the Z axis relative to the Normal orientation. Pressing Z again will remove all constraints. The current mode will be displayed in the left hand side of the 3D window header.

As can be seen in the *Axis locking modes* image, the direction of the transform also takes into account the selection. Sections A and B show Z axis locking in Global and Normal orientations respectively. C and D show the same situation with face selection, E and F with edge selection and G and H with vertex selection.

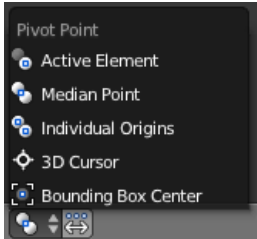
Note that using a locked axis does not prevent you from using the keyboard to enter [numeric transformation](#) values.

Pivot Point

Pivot Point selector

Mode: Object mode and Edit mode

Menu: Droplist in the header of the 3D view



Pivot Point modes.

The pivot point is the point in space around which all rotations, all scalings and all mirror transformations are centered. You can choose among five general modes for your pivot points which can be selected from a drop-down list in the header of any 3D area, as seen here in (*Pivot Point modes*). Your job is to choose the most efficient type for the task and to position pivot point accurately.

- [Active element](#)
- [Median Point](#)
- [Individual Origins](#)
- [3D Cursor](#)
- [Bounding Box Center](#)

Note that even if the above examples use meshes, the same rules apply for other types (curves, surfaces...) as well.

Object Centers

Each object has a center or origin point. The location of this point determines where the object is located in 3D space. When an object is selected, a small circle appears, denoting the origin point. The location of the origin point is important when rotating or scaling an object.

Moving Object Centers

Object Centers can be moved to different positions through the Object menu, under the Transform sub-menu:

- 3D Cursor Location
Moves the origin to the location of the 3d cursor. See [Using the 3D View](#) for more on using the 3d cursor.
- Median Point of Geometry
Moves the origin to the average position of the object's components.

Active Element as Pivot

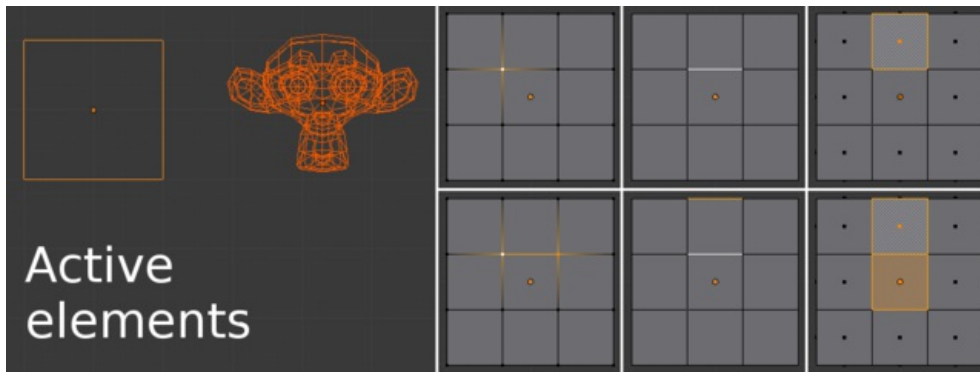
Mode: Object mode and Edit mode

Hotkey: Alt.

Menu: Select from the following icon in the 3D window header 

The *active* element can be an Object, vertex, edge or a face. The active element is the last one to be selected and will be shown in a lighter orange color when in Object mode and white when in Edit mode. With Active element as Pivot set to active, all transformations will occur relative to the active element.

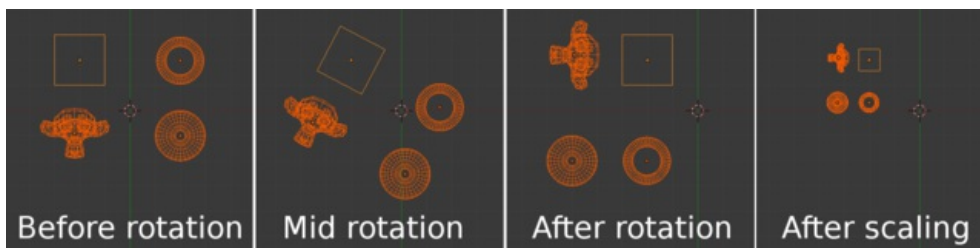
[Read more about selecting different pivot points »](#)



Display of active elements in Object mode is shown on the left of the image where the active element (cube) is a lighter orange. Active elements for vertices, edges and faces in Edit mode are displayed in white and are shown on the right.

In Object mode

When in Object mode, rotation and scaling happen around the active Object's center. This is shown by the figure to the below where the active Object (the cube) remains in the same location (note its position relative to the 3D cursor) while the other Objects rotate and scale in relation to the active element.



Rotation and scaling with the cube as the active element.

In Edit mode

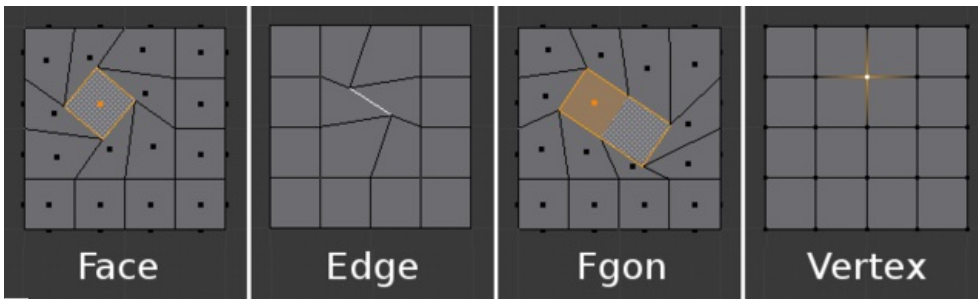
Using the active element as a pivot point in Edit mode may seem complex but all the possible transformations follow a few rules:

- The pivot point is always at the median of the active element(s).
- The transformations occur by transformation of the **vertices** of the selected element(s). If an unselected element shares one or more vertices with a selected element then the unselected one will get some degree of transformation also.

Let's examine the following examples: in each case we will see that the two rules apply.

Single selection

When one single element is selected it becomes automatically active. In the image below, you can see that when it is transformed its vertices move, with the consequence that any adjacent element which shares one or more vertices with the active element is also transformed.



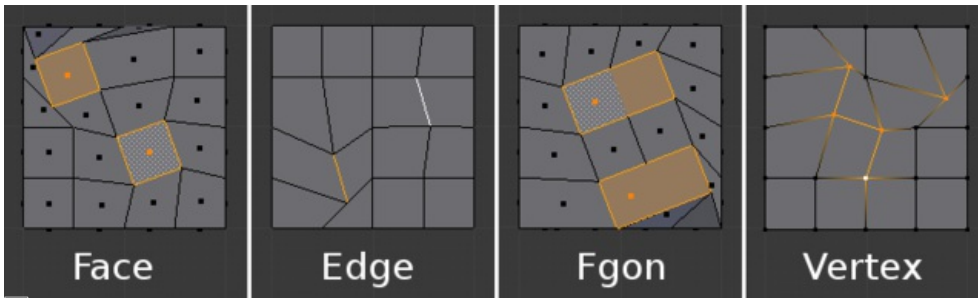
☐ Edit mode and only one element selected.

Let's review each case:

- *Faces* have their pivot point where their selection dot appears, which is where the median of their vertices is.
- *Edges* have their pivot point on their middle since this is always where the median of an edge is.
- *Fgons* behave the same as faces.
- A single *Vertex* has no dimensions at all so it can't show any transformation (except translation, which is not affected by the pivot point).

Multiple selection

When multiple elements are selected they all transform. The pivot points stay in the same place as what we've seen above, with only one exception for Fgons. In the image below, the selected elements have been rotated.



☐ Edit mode and multiple selections.

- For *Faces* the transformation occurs around the selection dot of the active face.
- *Edges* also keep the same behavior with their pivot point at their median.
- *Fgons* behave exactly like faces.
- There is a case for *Vertices* this time: the active Vertex is where the pivot point resides. All other vertices are transformed relative to it.

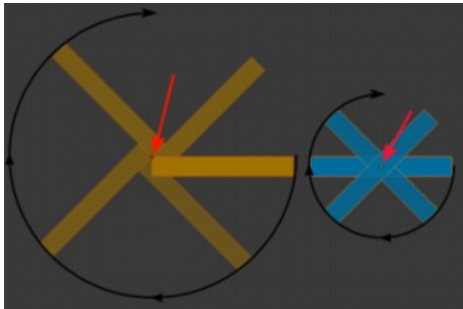
Individual Origins as Pivot

Mode: Object mode and Edit mode

Hotkey: Ctrl.

Menu: Select from the following icon in the 3D window header 

In Object mode



☐ Rotation around individual origins.

The Origin of an Object is shown in the 3D view by a small orange circle. This is highlighted in the image to the right by the red arrow. The origin tells Blender *where that Object is in 3D space*. What you see in the 3D view (vertices, edges etc) is what makes up the Object.

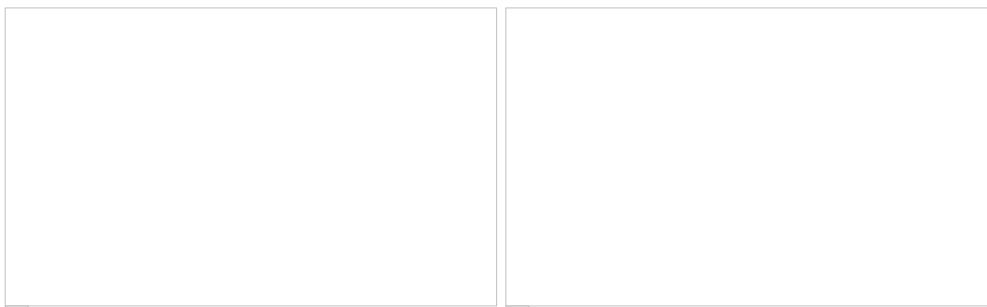
While the Origin is equivalent to the center of the *Object*, it does not have to be located in the center of the *Mesh*. This means that an Object can have its center located on one end of the mesh or even completely outside the mesh. For example, the orange rectangle in the image has its Origin located on the far left of the mesh.

Now let's examine *Rotation around the individual origins*.

- The blue rectangle has its Origin located in the center of the mesh, while the orange rectangle has its Origin located on the left hand side.
- When the Pivot Point is set to Individual Origins, the center of each Object (indicated by the red arrow) remains in place while the Object rotates around it in the path shown by the black arrow.

In Edit mode

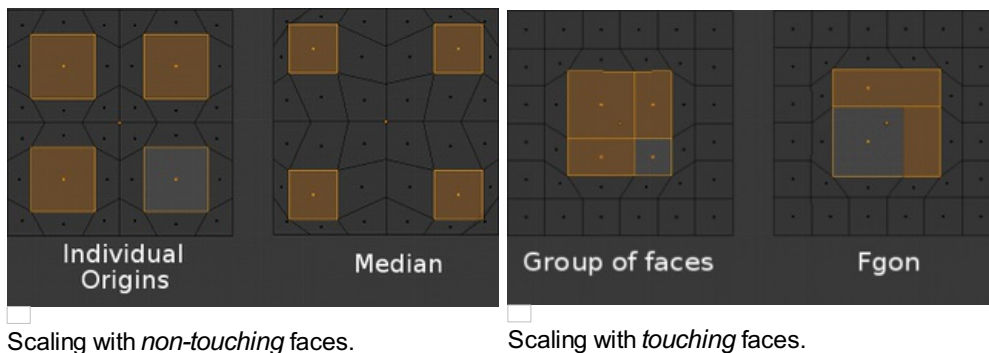
In Edit mode, setting the Pivot Point to Individual Origins produces different results when the selection mode is set to Vertex, Edge or Face. For example, Vertex mode produces results similar to setting the pivot point to median and Edge mode often produces distorted results. Using Individual Origins in Face mode produces the most predictable results.



☐ Rotation of individual faces with the pivot point indicated by the image text.

☐ Rotation of grouped faces with the pivot point indicated by the image text.

As can be seen in the images above, faces that touch each other will deform when rotated when the pivot point is set to Individual Origins. Faces that do not touch will rotate around their Individual Origins (their center).



Scaling with *non-touching* faces.

Scaling with *touching* faces.

Groups of faces and Fgons can be scaled without their outside perimeter being deformed. However, the individual faces inside will not be scaled uniformly.



Modeling with faces and individual origins as the pivot point.

Once you are aware of its limitations and pitfalls, this tool can save a lot of time and lead to unique shapes. This “anemone” was modeled from a 12 sided cylinder in about 10 minutes by repeatedly using this workflow: extrusions of individual faces, scaling with *median as a pivot point*, and scaling and rotations of those faces with *Individual Origins as pivot points*.

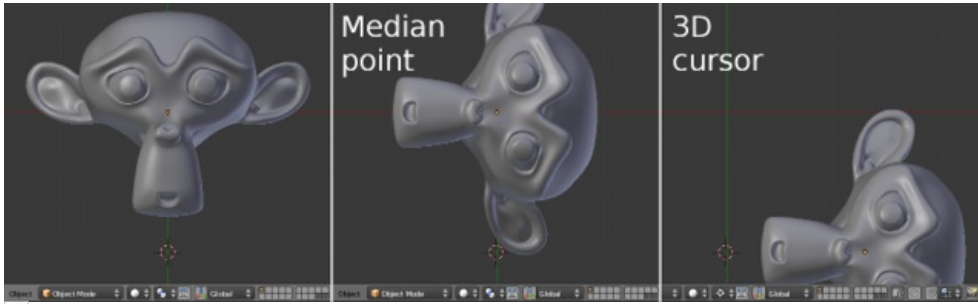
3D Cursor as Pivot

Mode: Object mode and Edit mode

Hotkey: .

The 3D cursor is the most intuitive of the pivot points. With the 3D cursor selected as the active pivot point (from either the Window Header or via the . hotkey), simply position the 3D cursor and then do the required transformation. All rotation and scaling transformations will now be done relative to the location of the 3D cursor. The image below shows the difference when rotating an Object from its starting position (first panel) 90 degrees around the median point (second panel) and 90 degrees around the 3D cursor (third panel).

[Read more about selecting different pivot points »](#)

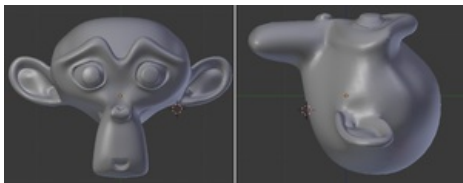


Rotation around the 3D cursor compared to the median point.


Positioning the 3D cursor

There are a few methods to position the 3D cursor.

Direct placement with the mouse



Positioning the 3D cursor with two orthogonal views.

- Using LMB  in the 3D area will place the 3D cursor directly under your mouse pointer. For accuracy you should use two perpendicular orthogonal 3D views, i.e. any combination of top (7 NumPad), front (1 NumPad) and side (3 NumPad). That way you can control the positioning along two axes in one view and determine depth in the second view.

Using the Snap menu

[The Snap menu.](#)

The Snap menu (⇧ ShiftS or Object/Mesh » Snap) will allow you to snap the cursor in the following ways:

- Cursor to Selected: snaps the cursor to the currently selected vertex, edge or face. In Object mode this option will snap the cursor to the center of the currently selected Object.
- Cursor to Center: snaps the cursor to the origin point of the grid (location 0,0).
- Cursor to Grid: snaps the cursor to the nearest **visible** part of the grid.
- Cursor to Active: snaps the cursor to the *active* (last selected) object, edge, face or vertex.

The Cursor to Selected option is also affected by the number of elements in the selection and the current pivot point. For example,

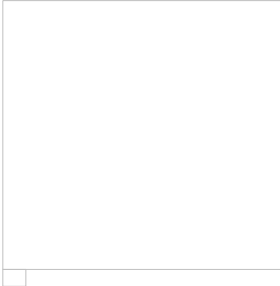
with several elements selected and the Bounding Box Center pivot point active, the Cursor to Selected option will snap the 3D cursor to the:

- **Center of the bounding box** surrounding the objects' centers in Object mode or the **center of the bounding box** surrounding the selected vertices when in Edit mode.

When the Median Point pivot point is selected, Cursor to Selected will snap the 3D cursor to:

- The median of the object centers in Object mode and the median of the selected vertices in Edit mode.

Numeric input



The 3D Cursor panel of the Properties shelf.

The 3D cursor can also be positioned by entering Numeric location values into the 3D cursor panel of the Properties shelf (N).

Median Point as Pivot

Mode: Object mode and Edit mode

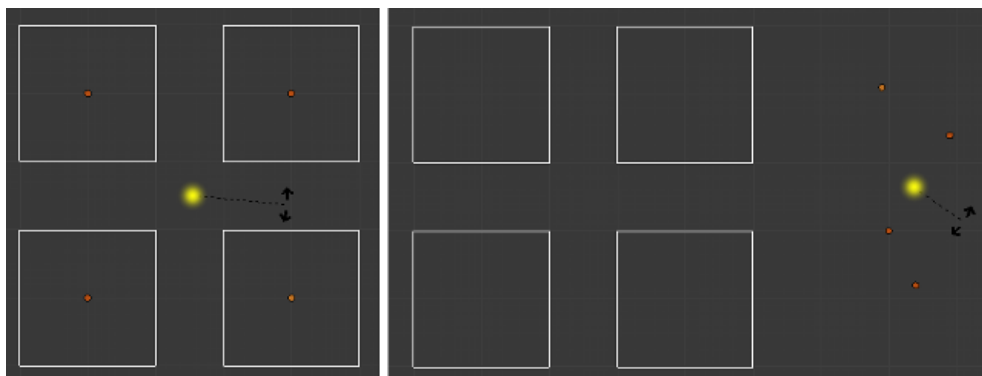
Hotkey: Ctrl,

Menu: Select from the following icon in the 3D window header 

The Median Point can be considered to be broadly similar to the concept of Center of Gravity (COG). If we assume that every element (Object, face, vertex etc) of the selection has the same mass, the median point would sit at the point of equilibrium for the selection (the COG).

In Object Mode

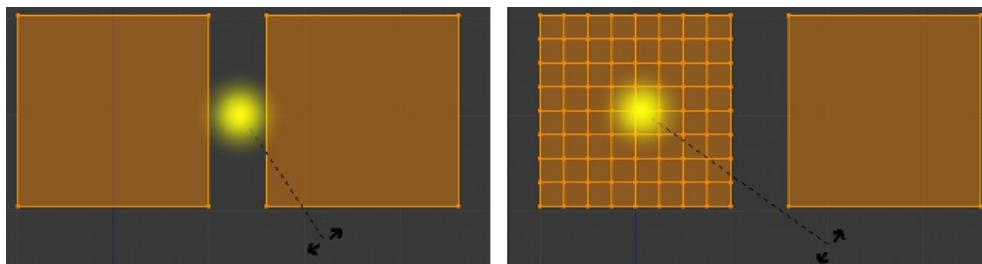
In Object Mode, Blender only considers the Object centers when determining the median point. This can lead to some counterintuitive results. In the Object Mode median points image below, you can see that the median point is between the Object centers and can be nowhere near the Objects' mesh.



☐ Median points in Object Mode. The Median point is indicated by the yellow dot.

In Edit Mode

In Edit Mode, the median point is determined via the part of the selection that has the most elements. For example, in the *Median points in Edit Mode* image, when there are two cubes with an equal number of vertices, the median point lies directly between the two cubes. However, if we subdivide one cube multiple times so that it has many more vertices, you can see that the median point has shifted to the region with the most vertices.



☐ Median points in Edit Mode. The Median point is indicated by the yellow dot.

Bounding Box Center as Pivot

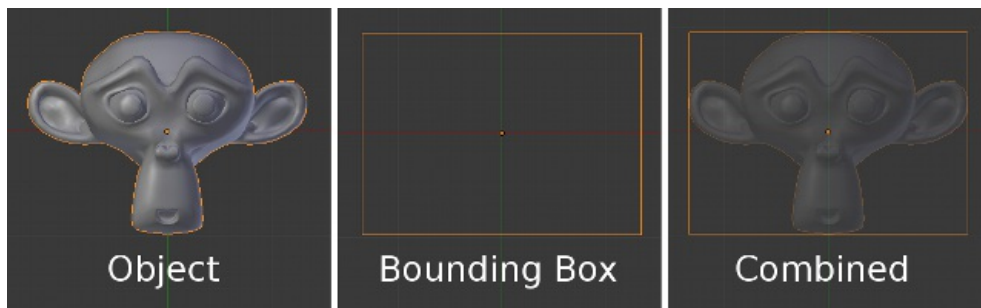
Mode: Object mode and Edit mode

Hotkey: ,

Menu: Select from the following icon in the 3D window header 

The bounding box is a rectangular box that is wrapped as tightly as possible around the selection. It is oriented parallel to the world axes. In this mode the pivot point lies at the center of the bounding box. You can set the pivot point to bounding box with the , hotkey or via the menu in the Window Header. The image below shows how the Object's Bounding Box size is determined by the size of the Object.

[Read more about selecting different pivot points »](#)

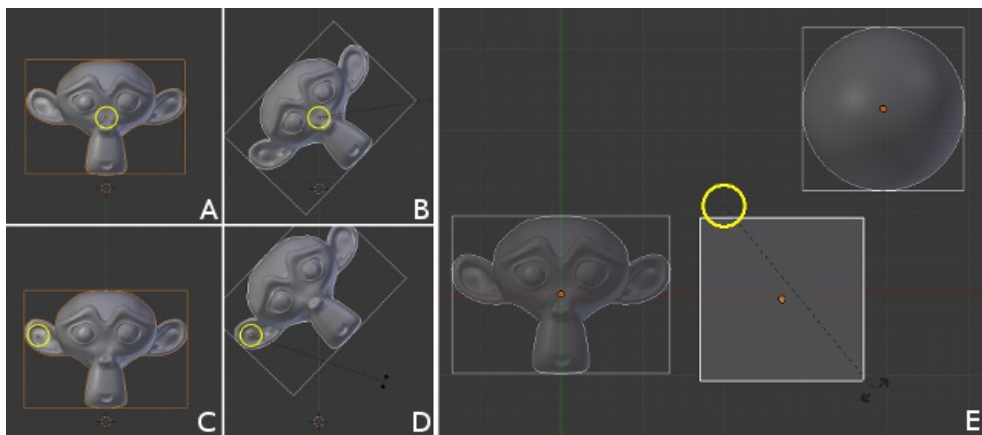


Relationship between an Object and its Bounding Box.

In Object mode

In Object mode, the bounding box is wrapped around the Object and transformation takes place relative to the location of the Object center (indicated by the yellow circle). The image below shows the results of using the Bounding Box as the pivot point in a number of situations.

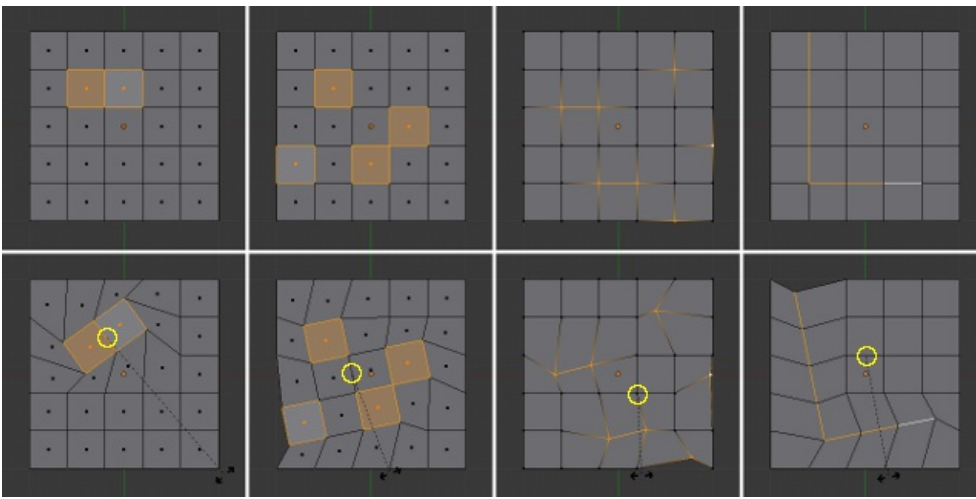
For example, images A (before rotation) and B show rotation when the Object center is in its default position, while images C (before rotation) and D shows the result when the Object center has been moved. Image E shows that when multiple Objects are selected, the pivot point is calculated based on the Bounding Box of all the selected Objects.



The grid of four images on the left (ABCD) shows the results of Object rotation when the pivot point is set to Bounding Box. The image to the right (E) shows the location of the Bounding Box pivot point when multiple Objects are selected. The pivot point is shown by a yellow circle.

In Edit mode

This time it is the ObData that is enclosed in the bounding box. The bounding box in Edit mode takes no account of the Object(s) centers, only the center of the selected vertices.



The effects of rotation in different mesh selection modes when the bounding box is set as the pivot point. The pivot point is shown by a yellow circle.

Retrieved from

"http://wiki.blender.org/index.php/Doc:2.6/Manual/3D_interaction/Transform_Control/Pivot_Point/Bounding_Box_Center"

Doc:2.6/Manual

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Snapping

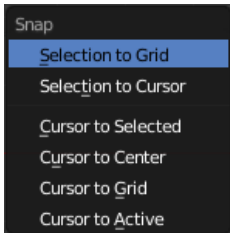
There are two types of snap operations that you can use in Blender. The first type snaps your selection or cursor to a given point while the second type is used during transformations (translate, rotate, scale) and snaps your selection to elements within the scene.

Snap

Mode: Object and Edit modes

Hotkey: ⇧ ShiftS

The Snap menu (also available from the 3D header in both Object and Edit mode (Object » Snap and Mesh » Snap). This menu provides a number of options to move the cursor or your selection to a defined point (the cursor, selection or the grid).



Snap menu

Selection to Grid

Snaps the currently selected object(s) to the nearest grid point.

Selection to Cursor

Snaps the currently selected object(s) to the cursor location.

Cursor to Selected

Moves the cursor to the center of the selected object(s).

Cursor to Center

Moves the cursor to the center of the grid.

Cursor to Grid

Moves the cursor to the nearest grid point.

Cursor to Active

Moves the cursor to the center of the active object.

Transform Snapping

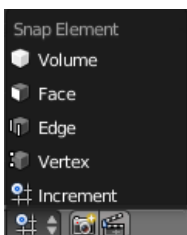
The ability to snap Objects and Mesh element to various types of scene elements during a transformation is available by toggling the magnet icon (which will turn red) in the 3D view's header buttons.



Magnet icon in the 3D view header
(red when enabled).

Snapping Modes

Snap Element



Snap Element
menu

Volume

Snaps to regions within the volume of the first Object found below the mouse cursor. Unlike the other options, this one controls

the depth (i.e. Z-coordinates in current view space) of the transformed element. By toggling the button that appears to the right of the snap target menu (see below), target objects will be considered as a whole when determining the volume center.

Face

Snap to the surfaces of faces in mesh objects. Useful for retopologizing.

Edge

Snap to edges of mesh objects.

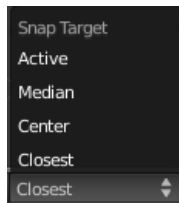
Vertex

Snap to vertices of mesh objects.

Increment

Snap to grid points. When in Orthographic view, the snapping increment changes depending on zoom level.

Snap Target



Snap Target menu.

Snap target options become active when either Vertex, Edge, Face, or Volume is selected as the snap element. These determine what part of the selection snaps to the target objects.

Active

move the active element (vertex in Edit mode, object in Object mode) to the target.

Median

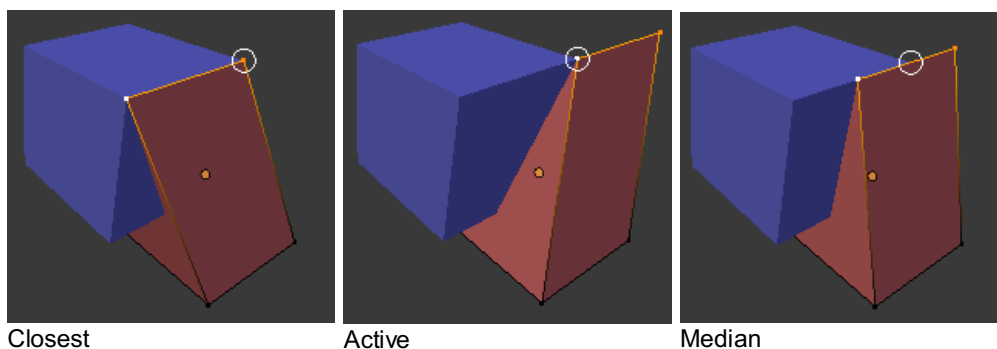
move the median of the selection to the target.

Center

move the current transformation center to the target. Can be used with 3D cursor to snap with an offset.

Closest





move the closest point of the selection to the target.



Additional snap options



As seen by the red highlighted areas in the image above, additional controls are available to alter snap behaviour. These options vary between mode (Object and Edit) as well as Snap Element. The four options available are:

-  Align rotation with the snapping target.
-  Project individual elements on the surface of other objects.
-  Snaps elements to its own mesh.
-  Consider Objects as whole when finding volume center.

Snapping

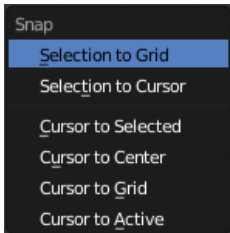
There are two types of snap operations that you can use in Blender. The first type snaps your selection or cursor to a given point while the second type is used during transformations (translate, rotate, scale) and snaps your selection to elements within the scene.

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Mode: Object and Edit modes

Hotkey: ⇧ ShiftS

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Cursor to Selected

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Cursor to Center

Moves the cursor to the center of the grid.

Cursor to Grid

Moves the cursor to the nearest grid point.

Cursor to Active

Moves the cursor to the center of the active object.

Transform Snapping

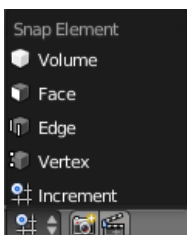
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Magnet icon in the 3D view header
(red when enabled).

Snapping Modes

Snap Element



Snap Element
menu

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Face

Snap to the surfaces of faces in mesh objects. Useful for retopologizing.

Edge

Snap to edges of mesh objects.

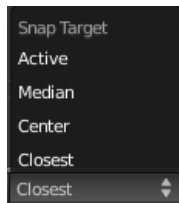
Vertex

Snap to vertices of mesh objects.

Increment

Snap to grid points. When in Orthographic view, the snapping increment changes depending on zoom level.

Snap Target



Snap Target menu.

Snap target options become active when either Vertex, Edge, Face, or Volume is selected as the snap element. These determine what part of the selection snaps to the target objects.

Active

move the active element (vertex in Edit mode, object in Object mode) to the target.

Median

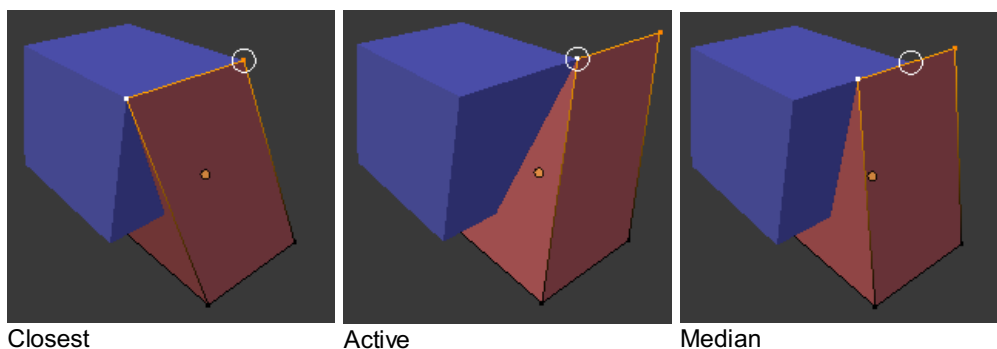
move the median of the selection to the target.

Center

move the current transformation center to the target. Can be used with 3D cursor to snap with an offset.

Closest





move the closest point of the selection to the target.



Additional snap options



As seen by the red highlighted areas in the image above, additional controls are available to alter snap behaviour. These options vary between mode (Object and Edit) as well as Snap Element. The four options available are:

-  Align rotation with the snapping target.
-  Project individual elements on the surface of other objects.
-  Snaps elements to its own mesh.
-  Consider Objects as whole when finding volume center.

Proportional Edit

Proportional Edit is a way of transforming selected elements (such as vertices) while having that transformation affect other nearby elements. For example, having the movement of a single vertex cause the movement of unselected vertices within a given range. Unselected vertices that are closer to the selected vertex will move more than those farther from it (i.e. they will move proportionally relative to the location of the selected element). Since proportional editing affects the nearby geometry, it is very useful when you need to smoothly deform the surface of a dense mesh.

Sculpting

Blender also has [Sculpt Mode](#) that contains brushes and tools for proportionally editing a mesh without seeing the individual vertices.

Object mode

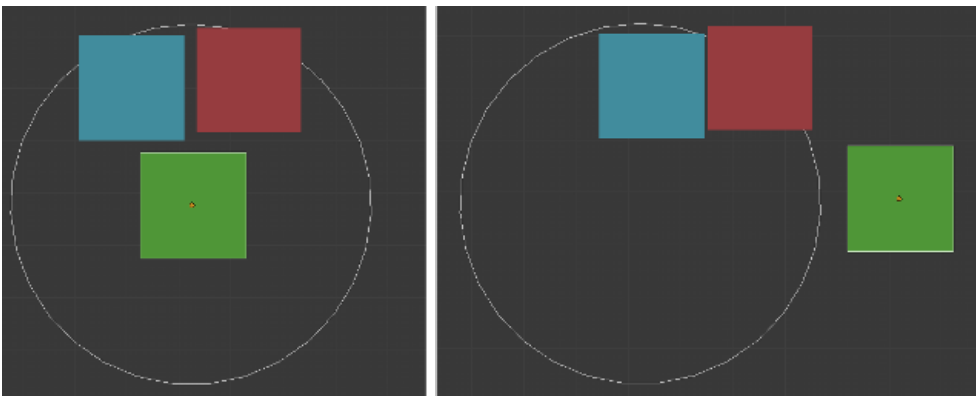
Mode: Object mode

Hotkey: O

Menu: Via the icon in the header indicated by the yellow square in the below image.



Proportional editing is typically used in Edit mode, however, it can also be used in Object mode. In Object mode the tool works on entire objects rather than individual mesh components. In the image below, the green cube is the active Object, while the red and blue cubes are located within the proportional edit tool's radius of influence. When the green cube is moved to the right, the other two cubes follow the movement.



Proportional editing in Object mode.

Edit mode

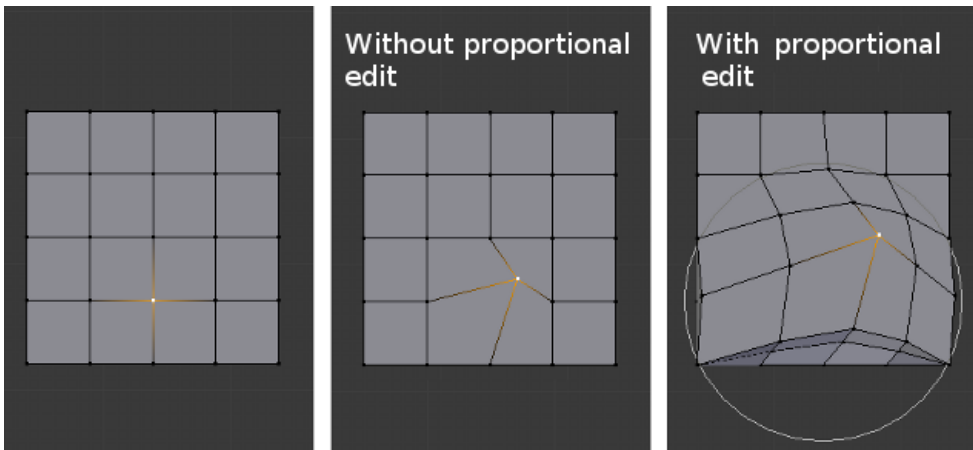
Mode: Edit mode

Hotkey: O / AltO / ⇧ ShiftO

Menu: Mesh » Proportional Editing and via the highlighted icon in the below image





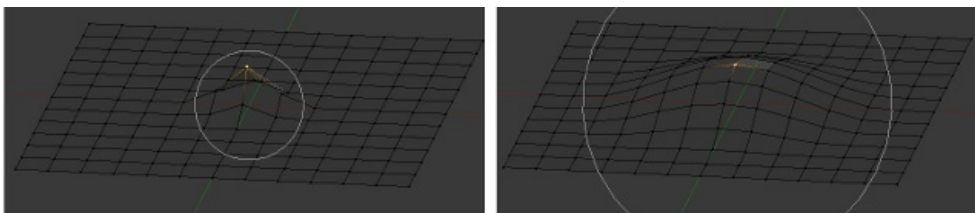
When working with dense geometry, it can become difficult to make subtle adjustments to the vertices without causing visible lumps and creases in the model's surface. When you face situations like this the proportional editing tool can be used to smoothly deform the surface of the model. This is done by the tool's automatic modification of unselected vertices within a given range.



Proportional editing in Edit mode.

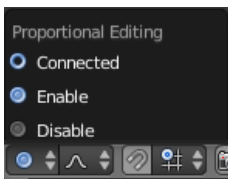
Influence

You can increase or decrease the radius of the proportional editing influence with the mouse wheel **WheelUp** / **WheelDown**  or **PageUp**/**PageDown** respectively. As you change the radius, the points surrounding your selection will adjust their positions accordingly.

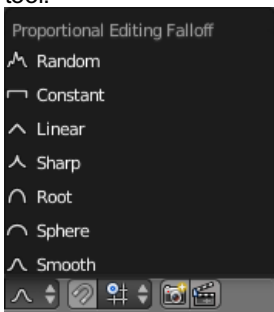


Influence circle.

Options



Proportional Editing tool.



Falloff menu.

The Proportional Editing mode menu is on the 3D View header.

Disable (O or AltO)

Proportional Editing is Off, only selected vertices will be affected.

Enable (O or AltO)

Vertices other than the selected vertex are affected, within a defined radius.

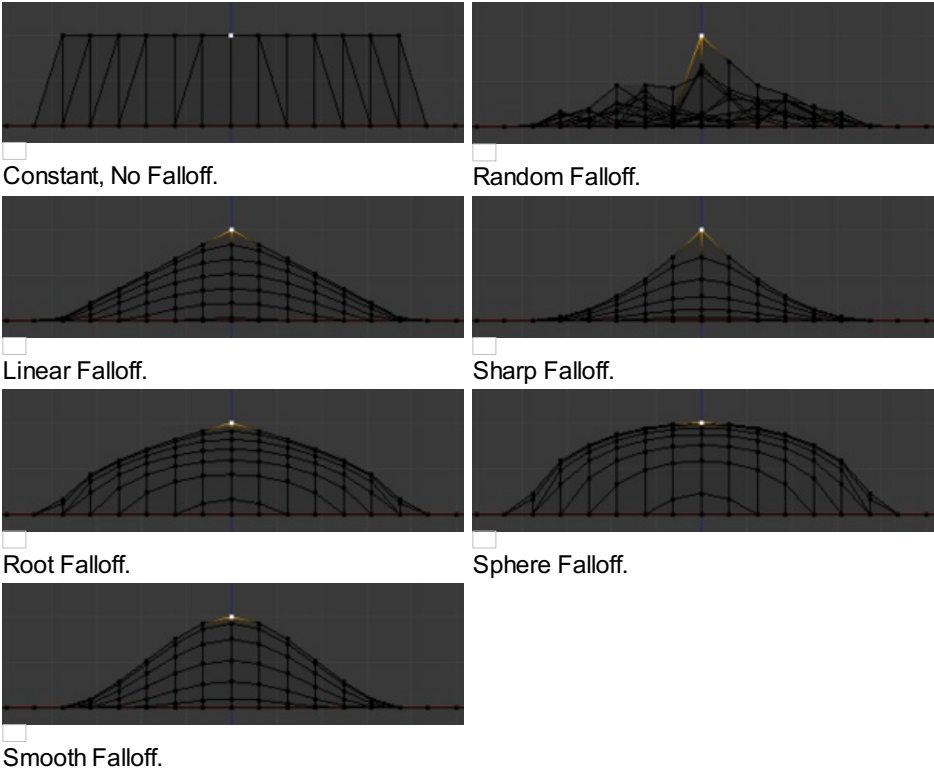
Connected (AltO)

Rather than using a radius only, the proportional falloff spreads via connected geometry. This means that you can proportionally edit the vertices in a finger of a hand without affecting the other fingers. While the other vertices are physically close (in 3D space), they are far away following the topological edge connections of the mesh. The icon will have a grey center when Connected is active. This mode is only available in Edit mode.

Falloff

While you are editing, you can change the curve profile used by either using the Mesh » Proportional Falloff submenu, using the

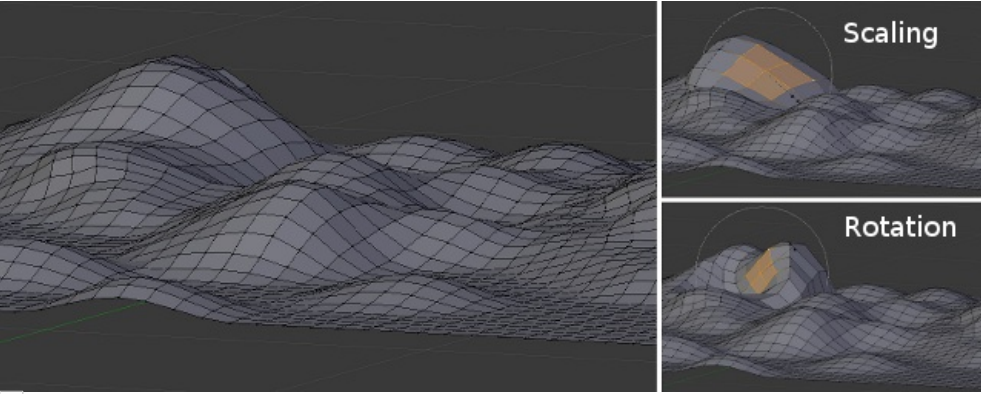
toolbar icon (*Falloff menu*), or by pressing ⇧ ShiftO to toggle between the various options.



Examples

Switch to a front view (1 NumPad) and activate the grab tool with G. As you drag the point upwards, notice how nearby vertices are dragged along with it. When you are satisfied with the placement, click LMB to fix the position. If you are not satisfied, cancel the operation and revert your mesh to the way it looked before with RMB (or Esc).

You can use the proportional editing tool to produce great effects with the scaling (S) and rotation (R) tools, as *A landscape obtained via proportional editing* shows.



A landscape obtained via proportional editing.

Combine these techniques with vertex painting to create fantastic landscapes. The *final rendered landscape* image belows shows the results of proportional editing after the application of textures and lighting.



Final rendered landscape.

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Images images are correct

Proposed fixes: none

Introduction

This page and its sub-pages are based on the [grease pencil release logs for blender 2.48](#).

The ability to draw in and/or on viewports using freehand strokes to form sketches and annotations has many benefits for collaborative communication and planning. This can be linked back to traditional 2D-workflows with pencil and paper, where rough “guideline” sketches were often used for planning and also for communicating ideas quickly. It is often useful to be able to directly scribble on to a work in progress, instead of having to do so in a separate place (i.e. another part of the window, or even in a different application altogether).

What is Grease Pencil?

The name “Grease Pencil” is derived in homage to the wax crayons/pencils that early CG Animators used to draw arcs and other planning notes on their CRT’s with.

In addition to uses for animators in planning their poses and motion curves, Grease Pencil can also be useful in a number of scenarios, including but not limited to:

- Planning topology and/or layout of models.
- Director’s shot review tool.
- “Whiteboard” and assignment review tool for educators.

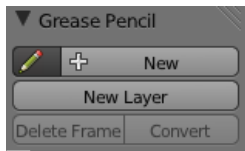


The Grease Pencil in action.

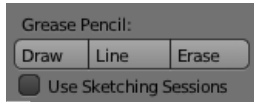
The next few pages explain how to use this tool:

- [Drawing sketches](#).
- [Layers and Animation](#).
- [Converting sketches to geometry](#).

Preparing



The Grease Pencil tool shelf.



The Grease Pencil properties panel.

- The first step when using Grease Pencil is to enable the display of Grease Pencil drawings. To do this, locate the Grease Pencil entry on the tool shelf (T if not open) and on the properties panel (N if not open).
- At this point, click on New Layer to add a new layer to draw on. This step is not necessary when you are starting off a new drawing (as a new layer will automatically be created for you), unless you want to customize the line width, color, or opacity before drawing. However, if you want to draw on a new layer once layers already exist, it is necessary to click on the button.

Grease Pencil is available for the following editor (window) types: 3D View and UV/Image Editor.

Draw a stroke

Mode: All modes

Panel: Object Tools » Grease Pencil » **Draw**

Hotkey: D LMB 

Description

Draw a new stroke (multiple short, connected lines). The stroke will finish when you release the mouse button.

Hints

While holding D, simply LMB  and release to make a dot.

Draw a line

Mode: All modes

Panel: Object Tools » Grease Pencil » **Line**

Hotkey: CtrlID LMB 

Description

Draw a new line in rubber band mode. The line will finish when you release the mouse button.

Erase stroke(s)

Mode: All modes

Panel: Object Tools » Grease Pencil » **Erase**

Hotkey: D RMB 

Description

Erases segments of strokes that fall within the radius of the eraser “brush”. The erasing will continue until the mouse button is released.

Options

The radius of the eraser “brush” is set under User Preferences » Editing » Grease Pencil » Eraser Radius.

Hints


If begun with **Erase**, either RMB  or LMB  will erase strokes.

Sketching Sessions

Mode: All modes

Panel: Object Tools » Grease Pencil » Use Sketching Sessions

Description

A Sketching Session allows for the rapid sketching with grease pencil when multiple strokes are desired. With this option set, when a grease pencil stroke is made a sketching session starts. Now, each time LMB  is pressed, a new stroke of the same type is begun. Use either Esc or ↵ Enter to exit the sketching session.

Hints

Either LMB  or RMB  is recognized for erasure.

Shared Grease Pencil Settings

Drawing Settings

At Transform Panel » Grease Pencil » Drawing Settings, there are up to four choices for drawing settings. These settings may be mixed within a grease pencil layer.

- **View** - New strokes are locked to the view. These strokes are *not* in 3D-space, but may be thought of as being drawn on the screen.
- **Cursor** (3D view only) - New strokes are drawn in 3D-space, with the position of their points being determined by the position of the 3D-cursor and the view rotation at the time (i.e. they are on the plane orthogonal to the view direction, and passing through the 3D cursor).
- **Surface** (3D view only) - New strokes are drawn in 3D-space, with their position being determined by the first visible surface “under” the stroke in the current view (i.e. they are projected onto said surface).
- **Stroke** (3D view only) - New strokes are drawn in 3D-space, with the position of their points being determined by the position of existing strokes in 3D-space which appear to be “under” the stroke in the current view (i.e. they are projected onto existing strokes). Note that strokes created with View are not in 3D-space and are not considered for this projection.

When using Surface or Stroke settings, if no part of a new stroke “lands” on a surface or existing stroke, the stroke does not appear to be saved. If some part of a new stroke does “land,” then all of the new stroke is saved.

Checking Transform Panel » Grease Pencil » Drawing Settings » Only Endpoints applies the drawing setting only to the endpoints; strokes between are adjusted to lie on a plane passing through the endpoints.

Limitations

Cursor is available in the UV/Image Editor but it appears to function as View – which it reverts to on ending the stroke.

Sensitivity When Drawing

The default settings for the sensitivity to mouse/stylus movement when drawing, have been set so that there shouldn’t be too much jitter while still allowing for fine details to be made. However, sometimes these settings may not be appropriate, in which case, the defaults can be found at User Preferences window » Editing » Grease Pencil.

- Manhattan Distance: The minimum number of pixels the mouse should have moved either horizontally or vertically before the movement is recorded. Decreasing this should work better for curvy lines.
- Euclidean Distance: The minimum distance that mouse should have traveled before movement is recorded. Imagine this as length of imaginary string between last recorded position and mouse-cursor.
- Eraser Radius: This is self-explanatory. It is simply the size of the eraser “brush”, so changing this will affect how likely strokes

are going to be covered within the eraser brush and thus erased.

- Smooth Stroke: This turns on the post-processing step of smoothing the stroke to remove jitter. It is only relevant when not drawing straight lines. By default this is on. It should be noted that it can often cause “shrinking” of drawings, and may be turned off if the results are not desirable.

For Tablet Users

- The thickness of a stroke at a particular point is affected by the pressure used when drawing that part of the stroke.
- The “eraser” end of the stylus can be used to erase strokes too.

Drawing Planes

Additional 2.5x Information

as a note for those that will edit the page for real, I'm putting here this video,

Layers

Grease Pencil sketches are organized in layers, much like those you could find in the GIMP or Photoshop. These layers are not related to any of the other layer systems in Blender, and also do not have an upper limit on the maximum number of layers that can be used. Like the layers in the aforementioned applications, these layers can also be renamed, locked, hidden, and deleted.

Their main purpose is to collect together a bunch of sketches that belong together in some meaningful way (i.e. “blocking notes”, “director’s comments on blocking”, or “guidelines”). For this reason, all the strokes on a layer (not just those made after a particular change) are affected by that layer’s color, opacity, and stroke thickness settings.

By default, most operations occur only on the *active* layer. The active layer can be identified as the one with the different panel color (in the default set, a light orangy-brown color). Clicking on a layer, or changing any of its settings will make it the new active layer.

The active layer can also be identified by looking at the status indicator (in the top right-hand corner of every view with Grease Pencil data being shown).

Animation of the Sketches

Grease Pencil can be used to do basic pencil tests (i.e. 2D animation in flipbook style). Sketches are stored on the frame that they were drawn on, as a separate drawing (only on the layer that they exist on). Each drawing is visible until the next drawing for that layer is encountered. The only exception to this is the first drawing for a layer, which will also be visible before the frame it was drawn on.

Therefore, it is simple to make a pencil-test/series of animated sketches:

1. Go to first relevant frame. Draw.
2. Jump to next relevant frame. Draw some more.
3. Keep repeating process, and drawing until satisfied. Voila! Animated sketches.

Onion Skinning

Onion-skinning (also known as ghosting), is a useful tool for animators, as neighboring frame(s) are lightly drawn by Blender. It allows animators to make judgments about movements, by comparing movement from different frames.

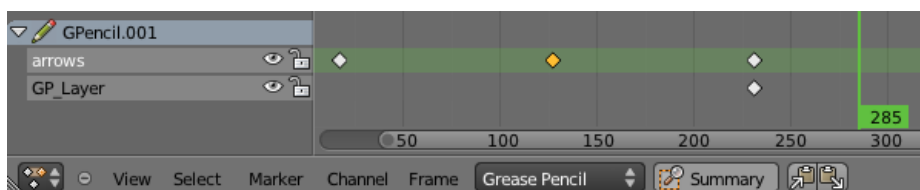
Usage Notes:

- Onion-skinning is enabled per layer by clicking on the Onion Skin button in the grease pencil properties panel.
- The Frames field, directly under the Onion Skin button, controls how many frames will be drawn. When Frames is **0**, only the drawing on either side of the current frame will be visible. Otherwise, this field specifies the maximum number of frames on either side of the current frame that will result in a neighboring drawing.

Adjusting Timing of Sketches

It is possible to set a Grease-Pencil block to be loaded up in the DopeSheet for editing of the timings of the drawings. This is especially useful for animators blocking out shots, where the ability to re-time blocking is one of the main purposes of the whole exercise.

1. In an Dope Sheet window, change the mode selector (found beside the menus) to Grease Pencil (by default, it should be set to DopeSheet).
2. At this point, the DopeSheet should now display a few “channels” with some “keyframes” on them. These “channels” are the layers, and the “keyframes” are the frames at which the layer has a sketch defined. They can be manipulated like any other data in the DopeSheet can be.



All the available Grease-Pencil blocks for the current screen layout will be shown. The Area/Grease-Pencil datablocks are drawn as green channels, and are named with relevant info from the views. They are also labeled with the area (i.e. window) index (which is currently not shown anywhere else though).

Copying Sketches

It is possible to copy sketches from a layer/layers to other layers in the Action Editor, using the “Copy”/“Paste” buttons in the header. This works in a similar way as the copy/paste tools for keyframes in the Action Editor.

Sketches can also be copied from one screen (or view) to another using these tools. It is important to keep in mind that keyframes will only be pasted into selected layers, so layers will need to be created for the destination areas too.

Page status ([reviewing guidelines](#))

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Proposed fixes: none

Converting Sketches to Other Forms

In the 3D view, sketches on the active layer can be converted to geometry, based on the current view settings. Sketches are converted into geometry by transforming the points recorded when drawing (which make up the strokes) into 3D-space (based on the current view settings). Currently, all points will be used, so it may be necessary to simplify or subdivide parts of the created geometry for standard use.

Sketches can currently be converted into one of two types, available in the Grease Pencil Convert menu popped-up by the Convert... button in the grease pencil properties panel:

- **Path**
- **Bezier Curve**

Each stroke is converted into a separate curve within a curve object that's named after the active layer. Handles are automatically set to be "free" handles (i.e. the black type), and are set to be in the same places as the control-points. The weight/radius of the curve at each control-point is set to equal the thickness of the stroke at each recorded point. However, in order to see that, you need to open a Transform Properties panel in Edit mode, Weight field.

Converting to Mesh

If you want to convert your sketch to a mesh, simply choose first Active Layer to Bezier, and then convert the created curve to a mesh...

Modeling in Blender

As you have seen in the [Quick Start](#) chapter, the creation of a 3D scene needs at least three key things: Models, Materials and Lights. In this Part we will delve deeper into the first of these issues: modelling. Modeling is the art and science of creating a surface that mimics the shape of a real-world object or fits your imagination of abstract objects.

Objects come in many forms, shapes and sizes, so Blender has many different tools available to help you make your model quickly and efficiently:

[Objects](#)

Working with objects as a whole

[Meshes](#)

Working with the mesh that defines the shape of an object

[Curves](#)

Using Curves to model and control objects

[Surfaces](#)

Modeling a NURBS surface

[Text](#)

Textual tools for putting words in 3D space

[Meta Objects](#)

Globs and Globules

[Duplications](#)

Duplicating Objects

[Modeling Scripts](#)

Since Blender functionality is extensible via Python, there are a number of very useful scripts that assist you in modelling.

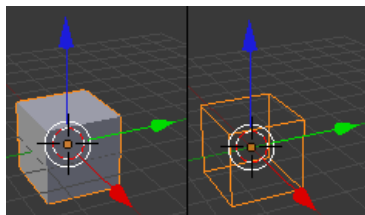
Many people use "box modelling" which starts with a basic cube, and proceeds with extruding faces and moving vertices to create a larger, more complicated mesh. For flat objects, like walls and table tops, you can use "curve modelling" which defines the outline using bezier or Nurbs curves, and then extrudes it to the desired thickness. Either method is fully supported in Blender using its modelling tools.

Proposed split

Text need to separate generic information from moving, erase join. like 2.4

Proposed fixes: none

Object Mode



Selected object.

The geometry of a scene is constructed from one or more Objects: For example Lamps, Curves, Surfaces, Cameras, Meshes, and the basic objects ("primitives") described in "[Mesh Primitives](#)".

Types of Objects

[Meshes](#)

Meshes are objects composed of Polygonal Faces, Edges and/or Vertices, and can be edited extensively with Blender's mesh editing tools.

[Curves](#)

Curves are mathematically defined objects, which can be manipulated with control handles or control points, rather than vertices.

[Surfaces](#)

Surfaces are four sided patches that are also manipulated with control points. These are useful for very organic, and rounded, but simple forms.

[Meta Objects](#)

Metaballs are objects formed by a function defining the 3d volume in which the object exists. Metaballs can create "Blobby" forms that have a liquid-like quality, when two or more Metaballs are used.

[Text](#)

Text objects create a 2d representation of a string of characters.

[Armatures](#)

Armatures are used for rigging 3d models in order to make them poseable and animateable.

[Empty](#)

Empties are null objects that are simple visual transform nodes that do not render. They are useful for controlling the position or movement of other objects.

[Cameras](#)

This is the virtual camera that is used to determine what appears in the render.

[Lamps](#)

These are used to place light sources in the scene.

[Force Fields](#)

Force fields are used in physical simulations. They give simulations external forces, creating movement, and are represented in 3d by small control objects.



Each object can be moved, rotated and scaled in Object Mode. However, not all of these transformations have an effect on all objects. For example, scaling a force field will not increase its effect.



For making other changes to the geometry of editable objects, you must use Edit mode.

Once you've added a basic object, you remain in Object Mode. In earlier versions of Blender, you were automatically switched into Edit mode if the Object were a Mesh, a Curve or a Surface.

You can switch between Object Mode and Edit Mode by pressing ⇧ Tab.

The object's wireframe, if any, should now appear orange, meaning that the object is now selected and active, as shown in (*Selected object*).

The (*Selected object*) image shows both the solid view and wireframe view of the default cube. To switch between wireframe and solid view, press Z.

Object Centers

Each object has a center or origin point. The location of this point determines where the object is located in 3D space. When an object is selected, a small circle appears, denoting the origin point. The location of the origin point is important when rotating or scaling an object. See [Pivot Points](#) for more.

Moving Object Centers

Object Centers can be moved to different positions through the Object menu, under the Transform sub-menu:

- 3D Cursor Location

Moves the origin to the location of the 3d cursor. See [Using the 3D View](#) for more on using the 3d cursor.

- Median Point of Geometry

Moves the origin to the average position of the object's components.

- Geometry to Origin

Move model to origin and this way origin of the object will also be at the center of the object.

- Origin to Geometry

Move origin to the center of the object and this way origin of the object will also be at the center of the object.

- Origin to 3D Cursor

Move origin of the model to the place of the 3D cursor.

Erase Objects

Mode: Edit or Object mode

Hotkey: X or Del

Menu: Object → Delete

Erases or deletes selected objects.

Join Objects

Mode: Object mode

Hotkey: CtrlJ

Menu: Object → Join Objects

Joins all selected objects of the same type to one single object whose center point is obtained from the previously *active* object. Performing a join is equivalent to adding new objects while in Edit mode. The non-active objects are deleted only the active object remains. This only works with editable objects, like meshes and curves.

Partial page Text missing Keying set

Proposed fixes: none

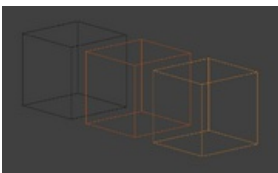
Introduction

Selection, in almost any program, determines which elements will be the target of our actions. As such, the more adapted the selection tool is to the action intended the better. Tools and functions are in a great number in Blender and so are its selection methods.

What follows is a short description of the concepts and selection tools which are available in Object mode.


Selections and the Active Object

Blender distinguishes between two different states of selection:



Unselected object in black, selected object in orange, and active object in yellow

- In Object mode the last (de)selected item is called the “Active Object” and is outlined in yellow (the others are orange). There is exactly one active object at any time (even when nothing is selected!).

Many actions in Blender use the active object as a reference, for example linking operations. If you already have a selection and need to make a different object the active one, simply re-select it with ⇧ Shift RMB .

- All other selected objects are just that, selected. You can select any number of objects.


Point Selection


The simplest form of object *selection* consists of using RMB  on it.

To *add to the selection*, use ⇧ Shift RMB  on more objects.

If the *objects are overlapping* in the view, you can use Alt RMB  to get a list of possible choices.

If you want to *add to a selection* this way then the shortcut becomes ⇧ ShiftAlt RMB .

To *activate an object* that is already selected, click ⇧ Shift RMB  on it.

To *deselect* an active object, click ⇧ Shift RMB  one time - and hence two clicks if the object isn't active.


Rectangular or Border Select

Mode: Object mode

Hotkey: B

Menu: Select → Border Select

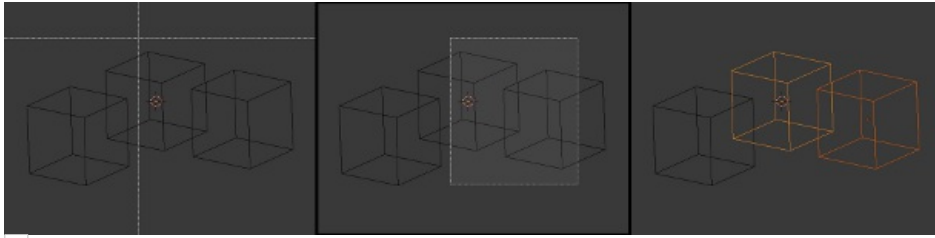
Description

With Border Select you draw a rectangle while holding down LMB . Any object that lies even partially within this rectangle becomes selected.



For deselecting objects, use MMB .

To cancel the selection use RMB .

Example



☐ Border selecting in three steps

In (*Border selecting...*), Border Select has been activated in the first image and is indicated by showing a dotted cross-hair cursor. In the second image, the *selection region* is being chosen by drawing a rectangle with the LMB . The rectangle is only covering two cubes. Finally, in the third image, the selection is completed by releasing LMB .

Notice in the third image, the bright color of left-most selected cube. This means it is the “active object”, the last selected object prior to using the Border Select tool.

Hints

Border select adds to the previous selection, so in order to select only the contents of the rectangle, deselect all with A first.

Lasso Select

Mode: Object mode

Hotkey: Ctrl LMB 


Menu: no entry in the menu

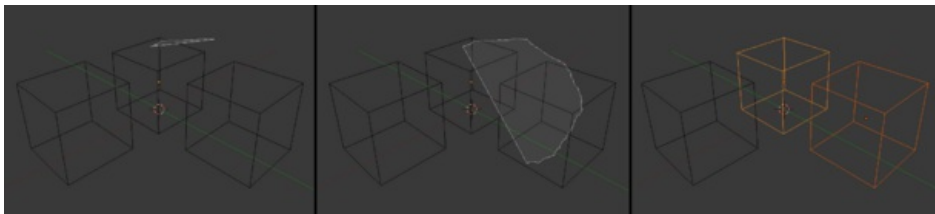
Description

Lasso select is used by drawing a dotted line around the pivot point of the objects, in Object mode.

Usage

While holding Ctrl down, you simply have to draw around the pivot point of each object you want to select with LMB .

Lasso select adds to the previous selection. For deselection, use Ctrl⇧ Shift LMB .



☐ Lasso selection example

Menu Selection

The selection methods described above are the most common. There are also many more options accessible through the Select menu of the 3D view.

Each is more adapted to certain operations.

Select Grouped

Mode: Object mode

Hotkey: ⇧ ShiftG

Menu: Select → Grouped

Description



Grouped selection menu

There are two ways to organize the objects in relation to one another. The first one is parenting, and the second is simple grouping. We can use these relationships to our advantage by selecting members of respective families or groups.

Options

Select → Grouped in Object mode uses the active object as a basis to select all others.

Available options are:

- Children
 - Selects all children of the active object recursively.
- Immediate Children
 - Selects all direct children of the active object.
- Parent
 - Selects the parent of this object if it has one.
- Siblings
 - Select objects that have the same parent as the active object. This can also be used to select all root level objects (objects with no parents).
- Type
 - Select objects that are the same type as the active one.
- Layer
 - Objects that have at least one shared layer.
- Group
 - Objects that are part of a group (rendered green with the default theme) will be selected if they are in one of the groups that the active object is in.
- Object Hooks
 - Every hook that belongs to the active object.
- Pass
 - Select objects assigned to the same render pass. Render passes are set in Properties → Object → Relations and can be used in the Node Compositor (Add → Convertor → ID Mask.)
- Color
 - Select objects with same Object Color. Object colors are set in Properties → Object → Display → Object Color.)
- Properties
 - Select objects with same Game Engine Properties.

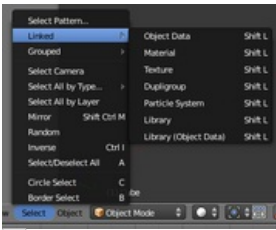
Select linked

Mode: Object mode

Hotkey: ⇧ ShiftL

Menu: Select → Linked

Description



Linked selection menu

Selects all objects which share a common datablock with the active object.

Options

Select → Linked in Object mode uses the active object as a basis to select all others.

Available options are:

Object Data

Selects every object that is linked to the same Object Data, i.e. the datablock that specifies the type (mesh, curve, etc.) and the built (constitutive elements like vertices, control vertices, and where they are in space) of the object.

Material

Selects every object that linked to the same material datablock.

Texture

Selects every object that linked to the same texture datablock.

Dupligroup

Selects all objects that uses the same Group for duplication.

Particle System

Selects all objects that uses the same Particle System

Library

Selects all objects that are in the same [Library](#)

Library (Object Data)

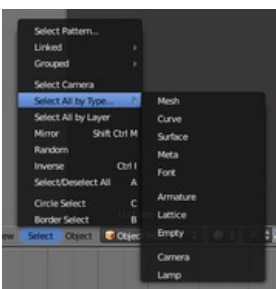
Select All by Type

Mode: Object mode

Hotkey: None

Menu: Select → Select All by Type

Description



By Type selection menu

The types are Mesh, Curve, Surface, Meta, Armature, Lattice, Text, Empty, Camera, Lamp.

With this tool it becomes possible to select every **visible** object of a certain type in one go.

Options

Select All by Type in Object mode offers an option for every type of object that can be described by the ObData datablock.

Just take your pick.

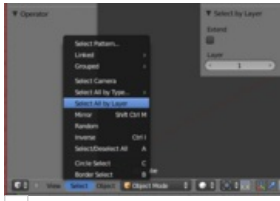
Select All by Layer

Mode: Object mode

Hotkey: None

Menu: Select → Select All by Layer

Description



All by Layer selection
menu

Layers are another means to regroup your objects to suit your purpose.

This option allows the selection of every single object that belongs to a given layer, visible or not, in one single command.

Options

In the Tool Shelf the following options are available:

Extend

Enable to add objects to current selection rather than replacing the current selection.

Layer

The layer on which the objects are.



Selection of Objects

Rather than using the Select All by Layer option, it might be more efficient to make the needed layers visible and use A on them. This method also allows objects to be deselected.

Other Menu Options

Available options on the first level of the menu are:

Random

Randomly selects unselected objects based on percentage probability on currently active layers. On selecting the command a numerical selection box becomes available in the Tool Shelf.

It's important to note that the percentage represents the likelihood of an unselected object being selected and not the percentage amount of objects that will be selected.

Inverse (Ctrl)

Selects all objects that were not selected while deselecting all those which were.

Select/Deselect All (A)

If anything was selected it is first deselected. Otherwise it toggles between selecting and deselecting every visible object.

Border Select (B)

As described above in the [section on border select](#).

Select Pattern

Selected all objects whose name matches a given pattern. Supported wildcards: * matches everything, ? matches any single character, [abc] matches characters in "abc", and [!abc] match any character not in "abc". The matching can be chosen to be case sensitive or not.

As an example *house* matches any name that contains "house", while floor* matches any name starting with "floor".

Page status ([reviewing guidelines](#))

Partial page Text need more info about Editing function, not all are in this page
Proposed fixes: none

Transforming Objects

Objects can be transformed in a variety of ways. These are well documented in the next section, [Manipulation in 3D](#). Below are the different types of transformations available in Object Mode:

- Translation
- Rotation
- Scale
- Mirror

Grouping And Parenting Objects

There can be many objects in a scene: A typical stage scene consists of furniture, props, lights, and backdrops. Blender helps you keep everything organized by allowing you to group like objects together.

When modeling a complex object, such as a watch, you may choose to model the different parts as separate objects. However, all of the parts may be attached to each other. In these cases, you want to designate one object as the parent of all the children. Movement and rotation of the parent also affects the children.

Parenting objects



Set Parent To
pop-up menu

To parent objects, select at least two objects (Select the child objects first, and select the parent object last), and press CtrlP. A confirmation dialog will pop up asking Make Parent. Selecting Make Parent confirms and the child/children to parent relationship is created. The last object selected will be the *active* object (outlined in yellow), and will also be the *parent* object. If you selected multiple objects before selecting the parent, they will all be children of the parent and will be at the same level of the hierarchy (they are “siblings”).

For non-inverse-mode press ⇧ ShiftCtrlP instead. This creates an alternative parent-child-relationship where child-objects exist entirely in parent coordinate system. This is the better choice for CAD purposes for example.

Moving and rotating the parent will also usually move/rotate the child/children. However moving/rotating the child/children of the parent, will not result in the parent moving/rotating. In other words, influence is usually descendant (parent → child/children), and not ascendant (child/children → parent).

Vertex Parent

You can parent an object to a single vertex or a group of three vertices as well; that way the child/children will move when the parent mesh is deformed, like a mosquito on a pulsing artery. In Object mode, select the child/children and then the parent object. ⇄ Tab into Edit mode and on the parent object select either one vertex that defines a single point, or select three vertices that define an area (the three vertices do not have to form a complete face they can be any three vertices of the parent object), and then hit CtrlP and confirm.

At this point if a single vertex was selected a relationship/parenting line will be drawn from the vertex to the child/children. If three vertices were selected then a relationship/parenting line is drawn from the averaged center of the three points (of the parent object) to the child/children. Now, as the parent mesh deforms and the chosen parent vertex/vertices move, the child/children will move as well.

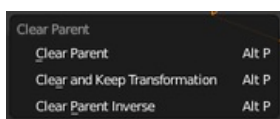
Note
It is in fact a sort of “reversed” [hook](#)

Options

Move child

You can *move* a child object to its parent by clearing its origin. The relationship between the parent and child isn’t affected. Select the child object and press AltO. By confirming the dialog the child object will snap to the parent’s location. Use the Outliner view to verify that the child object is still parented.

Remove relationship/Clear Parent



Clear Parent pop-up
menu

You can *remove* a parent-child relationship via AltP

The menu contains:

Clear Parent

If the parent in the group is selected nothing is done. If a child or children are selected they are disassociated with the parent, or freed, and they return to their *original* location, rotation, and size.

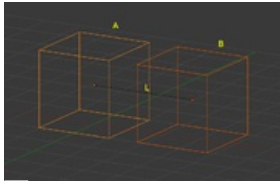
Clear and Keep Transformation

Frees the children from the parent, and *keeps* the location, rotation, and size given to them by the parent.

Clear Parent Inverse

Places the children with respect to the parent as if they were placed in the Global reference. This effectively clears the parent's transformation from the children. For example, if the parent is moved 10 units along the X axis and Clear Parent Inverse is invoked, any selected children are freed and moved -10 units back along the X axis. The "Inverse" only uses the last transformation; if the parent moved twice, 10 units each time for a total of 20 units, then the "Inverse" will only move the child back 10 units, not 20.

Parenting Example

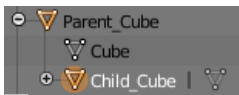


Parenting Example

The active object, in yellow (cube A), will be made the parent of all the other object(s) in the group (orange cube B). The center(s) of all children object(s) are now linked to the center of the parent by a dashed line; see image (*Parenting Example*). The parent object is cube "A" and the child object is cube "B". The link is labeled "L".

At this point, grabbing, rotating, and scaling transformations to the parent will do the same to the children. Parenting is a very important tool with many advanced applications, as we'll see in later chapters; it is used extensively with advanced animations.

Hints



Outliner view

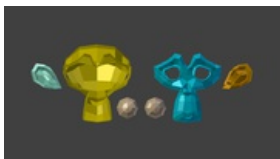
There is another way to see the parent-child relationship in groups and that is to use the Outliner view of the [Outliner window](#). Image (*Outliner view*) is an example of what the Outliner view looks like for the (*Parenting Example*). Cube "A"'s object name is "Cube_Parent" and cube "B" is "Cube_Child".

Separating Objects

At some point, you'll come to a time when you need to cut parts away from a mesh to be separate. Well, the operation is easy.

To separate an object, the vertices (or faces) must be selected and then separated, though there are several different ways to do this. In Edit Mode, press P then select one of the following.

Options



Suzanne dissected neatly

Selected

This option separates the selection to a new object.

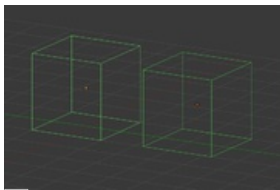
All Loose Parts

Separates the mesh in its unconnected parts.

By Material

Creates separate mesh objects for each material.

Grouping objects



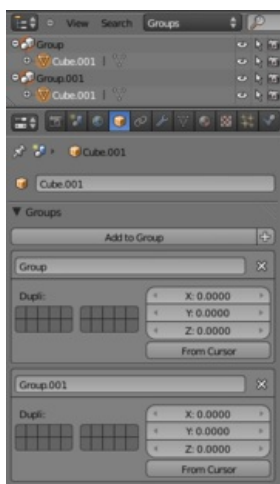
Grouped objects

Group objects together without any kind of transformation relationship. Use groups to just logically organize your scene, or to facilitate one-step appending or linking between files or across scenes. Objects that are part of a group always shows as light green when selected; see image (*Grouped objects*).

Options

Creating a Group

CtrlG creates a new group and adds the selected object(s) to it.



Naming a Group

Naming a Group

All groups that an objects have been assigned to are listed in the Object Properties Panel's Relations panel. To rename a group, simply click in the groups name field.

To name groups in the Outliner window, select Groups as the outliner display from the header combo box, and Ctrl LMB click on the group name. The name will change to an editable field; make your changes and press ↵ Enter.

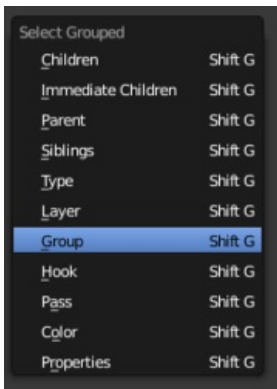
Restricting Group Contents via Layers

The cluster of layer buttons attached to each group determines from which layers the group objects will be included when duplicated. If your group contains objects on layers 10, 11 and 12, but you disable the layer 12 button in the group controls, duplicates of that group (using the [Dupligroup](#) feature) will only show the portions of the group that reside in layers 10 and 11.

Appending or Linking Groups

To append a group from another .blend file, consult [this page](#). In summary, File → Append or Link → filename → Group → groupname.

Select Grouped



Selected Grouped pop-up menu

⇧ ShiftG pops up a dialog for selecting objects based on parenting and grouping characteristics.

Options

Children

Selects all the active object's children, and the children's children, up to the last generation.

Immediate Children

Selects all the active object's children, but not those of these children (no "grandchildren" selected.)

Parent

Selects the parent of the active object and deselects the active object.

Siblings

Selects all the siblings of the active object.

Type

Selects objects based on the current active object type.

Layer

Selects all objects on the same layer(s) of the active object.

Group

Selects objects that belong to the same group as the active object.

Hook

Selects all [hooks](#) which are attached to the active object.

Pass

Selects all objects which have the same PassIndex number as the active object. See the [ID Mask node usage](#) for more information on this option.

Color

Selects objects that have the same color (the one set in Draw panel) as the active object.

Properties

Selects objects that have the same [game properties](#) as the active object.

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Text

wrong version

Old Track not applicable/available in 2.5

==Old Track==

http://wiki.blender.org/index.php/Doc:2.5/Manual/Modeling/Objects/Tracking#Old_Track

Proposed fixes: none

Tracking

Mode: Object mode

Panel: Object » Constraints

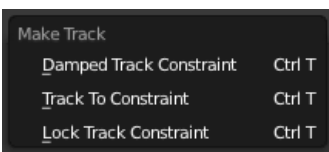
Hotkey: CtrlT

Menu: Object » Track » Make Track

Description

Tracking consists of one object watching another. The watcher is the “Tracker” and the watched is the “Target”. If the target moves the tracker rotates; if the tracker moves the tracker rotates. In both cases the tracker maintains a constant heading towards the target.

Types of Tracking



Make Track menu.

To make one or more objects track another object (the target), select at least two objects and press CtrlT. The active object becomes the target and the others objects the trackers. The (*Make Track menu*) provides several options for creating the initial tracking:

Track To Constraint

The Track To constraint applies rotations to its owner, so that it always points a given “To” axis towards its target, with another “Up” axis permanently maintained as much aligned with the global Z axis (by default) as possible. See: [Track To Constraint](#)

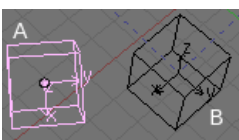
Locked Track Constraint

The Locked Track constraint is a bit tricky to explain, both graphically and textually. Basically, it is a Track To Constraint, but with a locked axis, i.e. an axis that cannot rotate (change its orientation). Hence, the owner can only track its target by rotating around this axis, and unless the target is in the plane perpendicular to the locked axis, and crossing the owner, this owner cannot really point at its target. See: [Locked Track Constraint](#)

Damped Track Constraint

The Damped Track constraint constrains one local axis of the owner to always point towards Target. See [Damped Track Constraint](#)

Old Track



Old Track “constraint”.


This is an older algorithm prior to version 2.30, and is similar to Track To constraint in that no axis is locked. This algorithm merely tries to keep a “To” axis pointed at the target. The tracking object will usually end up in an odd orientation when this constraint is first applied. In order to get correct results use AltR when applying or changing the tracking or “Up” axis. However, the preferred method to use is Track To constraint.

Let’s assume you have nonetheless selected Old Track in the dialog with two cubes selected; see (*Old Track “constraint”*). By default the inactive object(s) track the active object so that their local +Y axis points to the tracked object. Cube “A” is tracking cube “B” using the Old Track constraint. You can see that “A”’s +Y axis is pointing at “B” but at an odd orientation. This typically happens if the object already has a rotation of its own. You can produce correct tracking by canceling the rotation on the tracking object using AltR.

The orientation of the tracking object is also set such that the chosen “Up” axis is pointing upward.



Setting track axis.

If you want to change this you need to get to the Anim settings panel where Old Track’s settings are accessed. First select the tracking object (not the target) and change the Button window to Object context by clicking the icon () or F7; see (*Setting track axis*).

You then have the option of selecting the *Tracking axis* from the first column-set of six radio buttons and/or selecting the *upward-pointing* axis from the second column-set in the Anim Setting panel. Each time you change the “Up” axis you need to apply AltR otherwise the tracking object will continue to track with the old orientation. This is one of the drawbacks to using Old Track.

To clear or remove an old track “constraint”, select the tracking object and press AltT. As with clearing a parent constraint, you must choose whether to lose or save the rotation imposed by the tracking.

Note

AltT command works (and is useful) only for the Old Track “constraint”. To clear the Track To and Locked Track constraints, just delete them directly from the stack at the Constraints panel.

Hints

The *active* object always becomes the target object to be tracked. In all but Old Track a blue dashed line is drawn between the tracker and target indicating that a tracking constraint is in place between the corresponding objects. If you see an object tracking another object without a dashed blue line then you know the tracking object is using the Old Track “constraint”.

Invalid Tracking or settings

If you choose an invalid tracking “To” and/or “Up” axis, the tracking object keeps its current orientation and ignores the incorrect selections. For example, if you choose the +Z axis as the “To” axis and also choose the +Z axis as the “Up” axis, you have chosen an invalid combination because you can’t have the tracking object’s +Z axis doing two different things at the same time.

If you have problems setting up the correct “To” and “Up” axes you may want to turn on the tracking object’s local axes. You can do this from the Draw panel by clicking on the Axis button. See [The Interface](#) chapter for further details on the Draw panel.

Duplication

Mode: Edit and Object modes

Hotkey: ⇧ ShiftD

Menu: Object → Duplicate

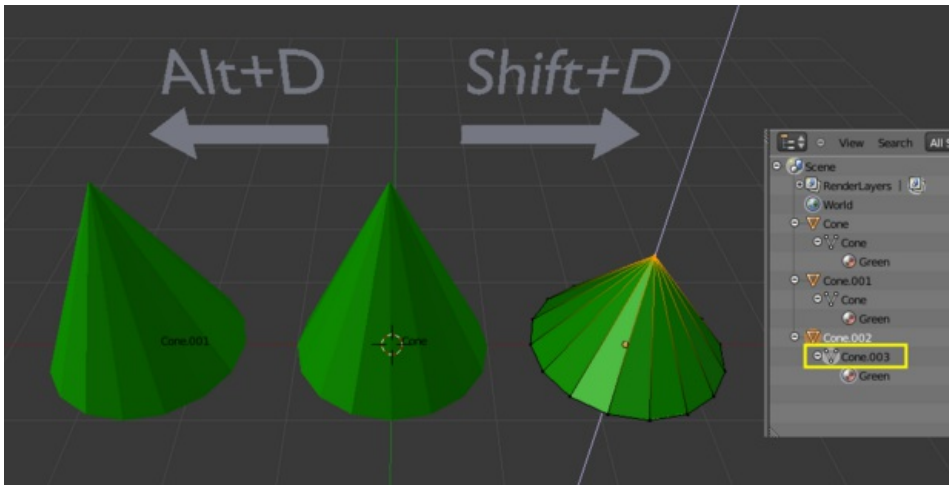
Description

This will create a visually identical copy of the selected object(s). The copy is created at the same position as the original object and you are automatically placed in Grab mode. Reference (*Duplicate Example*) for the discussions below.

This copy is a new object, which “**shares**” some datablocks with the original object (by default, all the Materials, Textures, and lpos), but which has copied others, like the mesh for example. This is why this form of duplication is sometimes called “shallow link”, because all datablocks aren’t shared, some of them are “hard copied”!

Note that you can choose which types of datablock will be linked or copied when duplicating: in the User Preferences' (available in the File menu) Editing “tab”, activate those types of datablocks you want to really copy in the Duplicate Data list — the others will just be linked.

Examples



The mesh Cone.006 of object Cone.002 is being edited. The mesh's Unique datablock ID name is highlighted in the Outliner.

The cone in the middle has been (1) link duplicated to the left and (2) duplicated to the right.

- The duplicated right cone is being edited, the original cone in the middle remains unchanged. The mesh data has been copied not linked.
- Likewise, if the right cone is edited in object mode, the original cone remains unchanged. The new object's transform properties or datablock is a copy, not linked.
- When the right cone was duplicated, it inherited the material of the middle cone. The material properties were linked, not copied.

See above if you want separate copies of the datablocks normally linked.

Linked Duplicates

Mode: Object mode

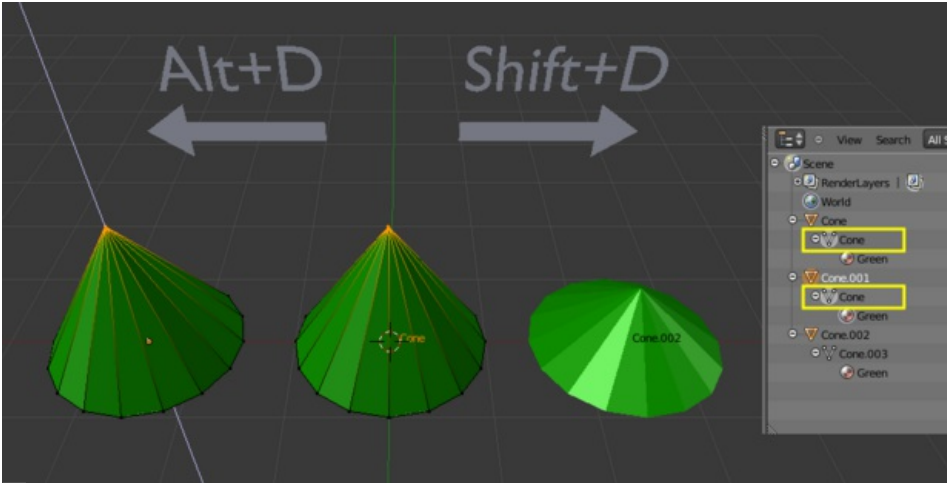
Hotkey: AltD

Menu: Object → Duplicate Linked

Description

You also have the choice of creating a *Linked Duplicate* rather than a *Duplicate*; this is called a deep link. This will create a new object with **all** of its data linked to the original object. If you modify one of the linked objects in Edit mode, all linked copies are modified. Transform properties (object datablocks) still remain copies, not links, so you still can rotate, scale, and move freely without affecting the other copy. Reference (*Duplicate Example*) for the discussions below.

Examples



The object Cone.001 was linked duplicated. Though both these cones are separate objects with unique names, the single mesh named Cone, highlighted in the Outliner, is shared by both.

The left cone is a Linked Duplicate of the middle cone (using AltD).

- As a vertex is moved in Edit mode in one object, the same vertex is moved in the original cone as well. The mesh data are linked, not copies.
- In contrast, if one of these two cones is rotated or rescaled in object mode, the other remains unchanged. The transform properties are copied, not linked.
- As in the previous example, the newly created cone has inherited the material of the original cone. The material properties are linked, not copied.

A common table has a top and four legs. Model one leg, and then make linked duplicates three times for each of the remaining legs. If you later make a change to the mesh, all the legs will still match. Linked duplicates also apply to a set of drinking glasses, wheels on a car... anywhere there is repetition or symmetry.

Procedural Duplication

Mode: Object mode and Edit mode

Panel: Object settings

There are currently four ways in Blender to procedurally duplicate objects. These options are located in the Object menu.

[Verts](#)

This creates an instance of all children of this object on each vertex (for mesh objects only).

[Faces](#)

This creates an instance of all children of this object on each face (for mesh objects only).

[Group](#)

This creates an instance of the group with the transformation of the object. Group duplicators can be animated using actions, or can get a [Proxy](#).

[Frames](#)

For animated objects, this creates an instance on every frame. As you'll see on this topic's subpage, this is also a very powerful technique for arranging objects and for modeling them.

Linked Library Duplication

Hotkey: ⇧ ShiftF1

Menu: File → Link Append

[Linked Libraries](#)

Linked Libraries are also a form of duplication. Any object or datablock in other .blend files can be reused in the current file.

Hints

- If you want transform properties (i.e. object datablocks) to be “linked”, see the page on [parenting](#).
- Material Transparency will not display when instancing dupli-groups, this is a known limitation of blenders view-port.

DupliVerts

Mode: Object mode

Panel: Object → Duplication

Duplication Vertices or DupliVerts is the duplication of a base object at the location of the vertices of a mesh. In other words, when using DupliVerts on a mesh, an instance of the base object is placed on every vertex of the mesh.

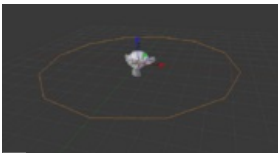
There are actually two approaches to modeling using DupliVerts. They can be used as an arranging tool, allowing us to model geometrical arrangements of objects (e.g. the columns of a Greek temple, the trees in a garden, an army of robot soldiers, the desks in a classroom). The object can be of any object type which Blender supports. The second approach is to use them to model an object starting from a single part of it (i.e.: the spikes in a club, the thorns of a sea-urchin, the tiles in a wall, the petals in a flower).

Download example .blend file

You can download a file with the examples described on this page. In [this .blend](#), the first example, a monkey parented to a circle, is on layer 1; while a tentacle parented to an icosphere is on layer 2. The files was made using Blender 2.55.1 (r33567).

DupliVerts as an Arranging Tool

Setup



A monkey head and a circle

All you need is a base object (e.g. the *tree* or the *column*) and a pattern mesh with it's vertices following the pattern you have in mind. In this section, we will use a simple scene for the following part. We'll be using a monkey head located at the origin of the coordinate system as our base object and a circle at the same location as our parent mesh.



Duplivered monkeys

First, in Object mode, select the base object and **⇧ Shift RMB** to add the circle to the selection (order is very important here), and **CtrlP** to parent the base object to the circle. Now, the circle is the parent of the monkey; if you move the circle, the monkey will follow it.

With only the circle selected, enable Duplication vertices in the Object panel→ Duplication→ Verts. A monkey head should be placed at every vertex of the circle.

The original monkey head at the center and the parent mesh are still shown in the 3D view but neither will be rendered. If the placement and rotation of your monkey head is odd, you might need to clear its rotation (**AltR**), scale **AltS**, location **AltG**, and origin **AltO**.

Rearranging

If you now select the base object and modify it in either object and edit mode, all changes will also affect the shape of all duplicate objects. You can also select the parent mesh to modify the arrangement of the duplicates; adding vertices will also add more base objects. Note that the base objects will inherit changes made to the parent mesh in object mode, but not in edit mode — so scaling the circle up in object mode will enlarge the monkey head, while scaling the circle up in edit mode will only increase the distance between the base objects.

Orientation



☐ Orientation enabled,
orientation +Y

The orientation of the base objects can be controlled by enabling Rotation in the Duplication panel. This will rotate all base objects according to the vertex normals of the parent mesh.

To change the orientation of the duplicated objects, select the base object and in the Object→ Relations extras panel change the Tracking Axes.

Output of various orientations



Negative Y

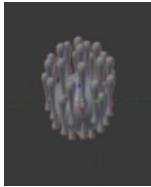
Positive X

Positive Z, up X

Note
The axes of an object can be made visible in the Object→ Display panel.
To display the vertex normals of the parent mesh, tab into edit mode and enable this function in Properties (N)→ Display panel where you can also resize the displayed normals as necessary.

DupliVerts as a Modeling Tool

Very interesting models can be made using DupliVerts and a standard primitive. In this example, a simple tentacle was made by extruding a cube a couple of times. The tentacle object was then parented to an icosphere. With dupli Rotation enabled for the parent mesh (the icosphere), the orientation of the base object (the tentacle) was adapted to the vertex normals of the parent mesh (in this case the tentacle was rotated -90° about the X axis in edit mode).



A simple tentacle set to smooth Tentacle duplverted onto the parent mesh Rotation enabled to align duplicates

As in the previous example, the shape and proportions of the arrangement can now be tweaked.

To turn all duplicates into real objects, simply select the icosphere and Object→ Apply→ Make Duplicates Real (Ctrl⇧ ShiftA). To make the icosphere and the tentacle a single object, make sure they are all selected and go to Object→ Join (CtrlJ).

See also

Other duplication methods are listed [here](#).

DupliFaces

Mode: Object mode

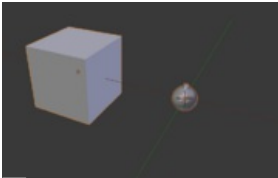
Panel: Object → Duplication

Duplication Faces or DupliFaces is the capability to replicate an object on each face of a parent object. One of the best ways to explain this is through an example illustration.

Example .blend file

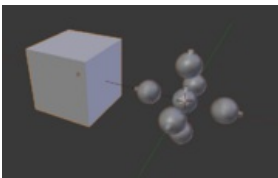
Download the .blend file used for the examples on this page [here](#)

Basic usage



A cube and a sphere

In this example we will use a UV sphere with an extruded "north pole" as our base object and cube as our parent mesh. To parent the sphere to the cube, in Object mode, first RMB select the sphere, then ⇧ Shift RMB select the cube (order is very important here), and finally CtrlP to parent.



Duplication Faces applied to the cube

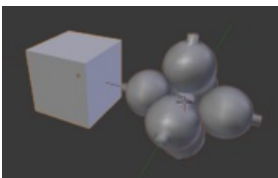
Next, in the Object context's Duplication panel, enable Faces. The sphere is duplicated one for each face of the cube.

Inherited properties

The location, orientation, and scale of the duplicated child(ren) matches that of the faces of the parent. So, if several objects are parented to the cube, they will all be duplicated once for each face on the cube. If the cube is subdivided (in Edit Mode W), every child will be duplicated for each face on the cube.

Both the parent object and original are displayed as editable "templates" in 3D view, but neither is rendered.

Scale



Scale enabled



Top face of cube scaled down

By enabling Scale for the parent object, the scale of the child objects will be adapted to the size of each face in the parent object.

Thus, by rescaling the face of the parent object, the size of the duplicated object will change accordingly.

DupliGroup

Mode: Object mode

Panel: Object → Duplication → Group

Duplication Group or DupliGroup allows you to create an instance of a group for each instance of another object.

Basic Usage

- Create a number of objects and group them by
 1. selecting them all,
 2. CtrlG, and
 3. eventually rename your group in Object → Groups
- Create a DupliGroup by
 1. adding another object (⇧ ShiftA), say an Empty,
 2. in Object → Duplication enable Group, and
 3. select the name of your newly created group in the selection box that appears.

DupliGroup and Dynamic Linking

See [Appending and Linking](#) to understand how to dynamically link data from another .blend file into the current file. You can dynamically link groups from one blend file to another. When you do so, the linked group does not appear anywhere in your scene until you create an object controlling where the group instance appears.

Example

- Link a group from another file into your scene, as described in [Appending and Linking](#).
From here, you can use the easy way or the hard way:
- The easy way:
 1. Select Add → Group Instance → [name of group you just linked].
- The hard way:
 1. Select Add → Empty, and select the empty that you added.
 2. Switch to the Object context, and in the Duplication panel, click Group.
 3. In the dropdown box that appears next to Group:, pick the group that you linked.

At this point, an instance of the group will appear. You can duplicate the empty, and the DupliGroup settings will be preserved for each empty. This way, you can get multiple copies of linked data very easily.

Making a DupliGroup Object Real

Say you want to make further edits on an DupliGroup instance or render the DupliGroup in Yafaray or some other render that does not support importing DupliGroups directly:

Simply select your DupliGroup and press Ctrl⇧ ShiftA to convert the DupliGroup into an regular objects that can be transformed and animated normally.

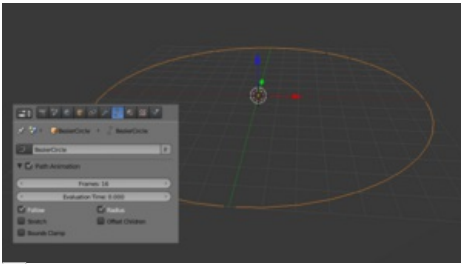
Note

Note that if the DupliGroup was linked from an external file the Object Data (mesh, materials, textures, transforms) will also still be linked from the original group. However, the various object's parent-child relationships do not carry over.

DupliFrames

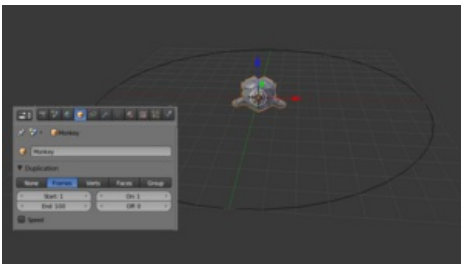
DupliFrames is a tool to duplicate objects at frames distributed along a path. This is a useful tool to quickly arrange objects.

Examples



Settings for the curve

⇧ ShiftA to add a Bezier Circle and scale it up. In the Curve menu under Path Animation enable Follow and set Frames to something more reasonable than 100 (say 16).

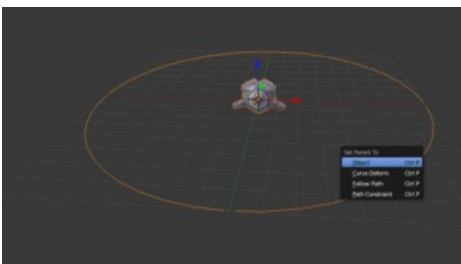


Settings for the object

Add a Monkey. In the Object menu under Duplication enable Frames and disable Speed.

Speed

The Speed option is used when the parent-child relationship is set to Follow Path (see below). In this example, the monkey will then travel along the circle over 16 frames.



Parenting

To parent the monkey to the Bezier circle, first select the monkey then the curve (so that the curve is the active object) and CtrlP. Select the monkey and AltO to reset its origin.



Orientation tweaks

You can now change the orientation of the monkey by either rotating it (either in Edit mode or Object mode) or by changing the Tracking Axes under Animation Hacks (with the monkey selected). The arrangement of monkeys can, of course, be further enhanced by editing the curve.

To transform all monkey into real objects, first Ctrl⇧A to Make Duplicates Real. All monkeys are now real objects, but still linked copies. To change this, Object→Make Single User→Object&Data then choose All.

Note

There are many alternatives to Dupliframes. Which tool to use depends on context.

1. To use a small curve as a profile and a larger curve as a path, simply use the former as a Bevel Object to the latter.
2. To arrange objects along a curve, combining an Array Modifier and a Curve Modifier is often useful.
3. Dupliverts can be used to arrange objects, for example, along a circle or across a subdivided plane.

External links

- [Blender Artists: *Dupliframes in 2.5*](#)

Edit Mode

Entering Edit Mode

You can work with geometric objects in two modes.

[Object mode](#)

Operations in Object Mode affect the whole object.

Object mode has the following header in the 3D view:



Object Mode header

Edit mode

Operations in Edit mode affect only the geometry of an object, but not global properties such as location or rotation.

Edit mode has the following header in the 3D view:



Edit Mode header

Tools and modes in the 3D view header are (left to right):

View, Select, and Mesh menus

Blender Mode

Display method for 3D view

Pivot center

3D manipulator widget

Selection mode

Depth buffer clipping (hide

Proportional editing

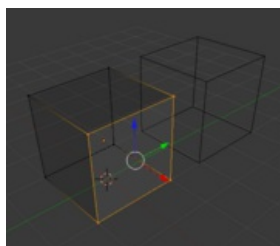
Snap

OpenGL render

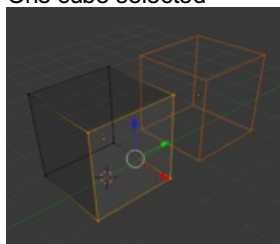
You switch between these two modes with the ⇧ Tab key or by selecting the desired Mode in the menu in the 3d view header.

After creating an object you may be immediately placed in Edit mode – depending on whether the Switch to Edit Mode button is toggled in the User Preferences Editing tab. Edit mode only applies to one object at a time, the *active*, or most recently selected, object.

Visualization



One cube selected



Two cubes selected
before entering Edit mode

By default, Blender highlights selected geometry in orange in both Object mode and Edit mode. The color can be changed in the User Preferences (CtrlAltU→Themes.)

In Object mode with Wireframe shading enabled (Z), objects are displayed in black when unselected and in orange when selected. If

more than one object is selected, all selected object except the active object, typically the object last selected, is displayed in a darker orange color. Similarly, in Edit mode, unselected geometry is drawn in black while selected faces, edges, or vertices are drawn in orange. The active face is highlighted in white.

In Edit mode, only one mesh can be edited at the time. However, several objects can be joined into a single mesh (CtrlJ in Object mode) and then separated again (P in Edit mode). If multiple objects are selected before entering Edit mode, all the selected objects remain highlighted in orange indicating that they are part of the active selection set.

If two vertices joined by an edge are selected in Vertex selection mode, the edge between them is highlighted too. Similarly, if enough vertices or edges are selected to define a face, that face is also highlighted.

Tool Shelf



The Tool Shelf panel in edit mode (panel split in two parts for layout reasons)

Open/close the Mesh Tools panel using T. When entering Edit mode, several mesh tools become available.

Most of these tools are also available as shortcuts (displayed in the Tooltips for each tool) and/or in the Specials menu (W), the Edge menu (CtrlE), and Face menu (CtrlF). For each tool a context-dependent menu is opened at the bottom of the Tool Shelf.

Even more mesh editing tools can be enabled in the User Preferences' Add-Ons section. The development of new tools is regularly announced on Blender-related sites and forums.

For further information on panels see the [Reference panels](#) section.

Properties Shelf



The Properties Shelf panel in edit mode (panel split in two parts for layout reasons)

Open/close the Properties Shelf using N.

In the Properties Shelf, panels directly related to mesh editing are the Transform panel, where numeric values can be entered, and the Mesh Display panel, where for example normals and numeric values for distances, angles, and areas can be turned on.

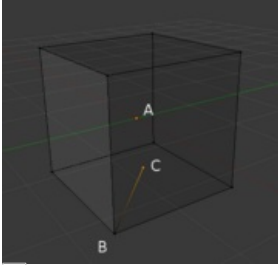
Other useful tools are found in the Properties Editor under the Object's and Object Data's Context buttons, including display options and Vertex groups.

For further information on panels see the [Reference panels](#) section.

Vertices, Edges and Faces


In basic meshes, everything is built from three basic structures: *Vertices*, *Edges* and *Faces* (we're not talking about curves, NURBS, and so forth here). But there is no need to be disappointed: this simplicity still provides us with a wealth of possibilities that will be the foundation for all our models.

Vertices



Vertex example

A vertex is primarily a single point or position in 3D space. It is usually invisible in rendering and in Object mode. Don't mistake the center point of an object for a vertex. It looks similar, but it's bigger and you can't select it. (*Vertex example*) shows the center point labeled as "A". "B" and "C" are vertices.

A simple way to create a new vertex is to click Ctrl LMB  in Edit mode. Of course, as a computer screen is two-dimensional, Blender can't determine all three vertex coordinates from a single mouse click, so the new vertex is placed at the depth of the 3D cursor. Using the method described above, any vertices selected previously are automatically connected to the new ones by an edge. In the image above, the vertex labeled C is a new vertex added to the cube with a new edge added between B and C.

Edges

An edge always connects two vertices by a straight line. The edges are the "wires" you see when you look at a mesh in wireframe view. They are usually invisible on the rendered image. They are used to construct faces. Create an edge by selecting two vertices and pressing F.

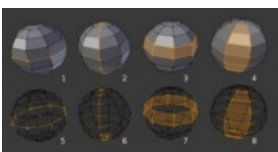
Faces

A face is the highest level structure in a mesh. Faces are used to build the actual surface of the object. They are what you see when you render the mesh. A face is defined as the area between either three (triangles) or four (quadrangles) vertices, with an edge on every side. Triangles are always flat and therefore easy to calculate. On the other hand, quadrangles "deform well" and are therefore preferred for subdivision modeling.

Take care when using four-sided faces (quads), because internally they are simply divided into two triangles each. Four-sided faces only work well if the face is pretty much flat (all points lie within one imaginary plane) and convex (the angle at no corner is greater than or equal to 180 degrees). This is the case with the faces of a cube, for example. That's why you can't see any diagonal in its wireframe model, because they would divide each square face into two triangles.

While you could build a cube with triangular faces, it would just look more confusing in Edit mode. An area between three or four vertices, outlined by edges, doesn't have to be a face. If this area does not contain a face, it will simply be transparent or non-existent in the rendered image. To create a face, select three or four suitable vertices and press F.

Loops



Edge and Face Loops

Edge and Face Loops are sets of faces or edges that form continuous "loops" as shown in (*Edge and Face Loops*). The top row (1-4) shows a solid view, the bottom row (5-8) a wireframe view of the same loops.

Note that loops 2 and 4 do not go around the whole model. Loops stop at so called poles because there is no unique way to continue a loop from a pole. Poles are vertices that are connected to either three, five, or more edges. Accordingly, vertices connected to exactly one, two or four edges are not poles.

In the image above, loops that do not end in poles are cyclic (1 and 3). They start and end at the same vertex and divide the model into two partitions. Loops can be a quick and powerful tool to work with specific, continuous regions of a mesh and are a prerequisite for organic character animation. For a detailed description of how to work with loops in Blender, please refer to the Manual page on [Edge and Face Tools](#).

Edge Loops

Loops 1 and 2 in (*Edge and Face Loops*) are edge Loops. They connect vertices so that each one on the loop has exactly two neighbours that are not on the loop and placed on both sides of the loop (except the start and end vertex in case of poles).

Edge Loops are an important concept especially in organic (subsurface) modeling and character animation. When used correctly, they allow you to build models with relatively few vertices that look very natural when used as subdivision surfaces and deform very well in animation.

Take (*Edge Loops in organic modeling*) as an example: the edge loops follow the natural contours and deformation lines of the skin and the underlying muscles and are more dense in areas that deform more when the character moves, for example at the shoulders or knees.

Further details on working with Edge Loops can be found in [Edge Loop Selection](#).

Face Loops

These are a logical extension of Edge Loops in that they consist of the faces between two Edge Loops, as shown in loops 3 and 4 in (*Edge and Face Loops*). Note that for non-circular loops (4) the faces containing the poles are not included in a Face Loop.

Further details on working with Face Loops can be found in [Face Loop Selection](#).

Page status ([reviewing guidelines](#))

Partial page Text need more detail about parameter for every primitive. Delete Addon because not official?

Proposed fixes: none

Basic Mesh Objects

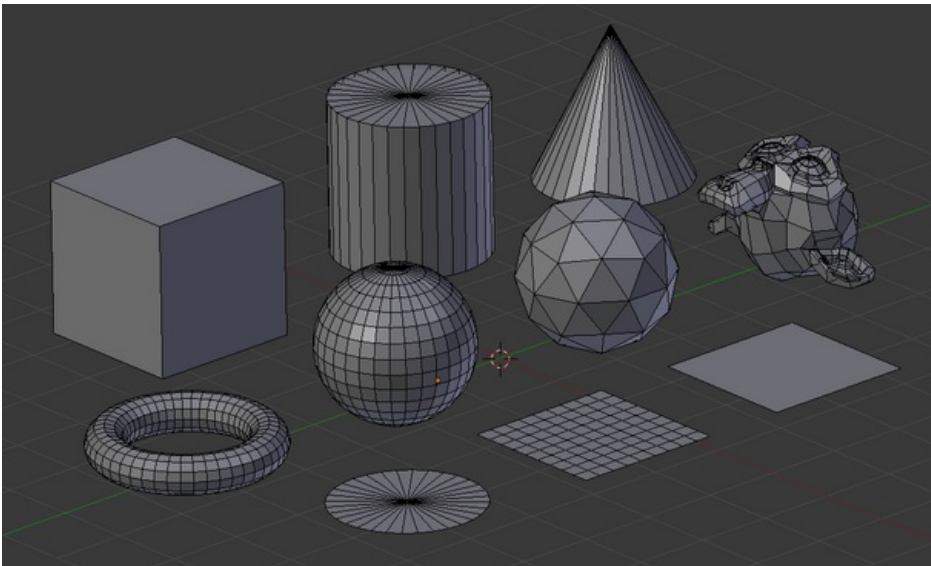
Mode: Object mode

Hotkey: \diamond ShiftA

Menu: Add » Mesh

Description

A common object type used in a 3D scene is a mesh. Blender comes with a number of “primitive” mesh shapes that you can start modeling from.



Blender's ten standard primitives

Options included in more than one primitive are:

Radius

Sets the starting size for Circle, Cylinder, Cone, UVSphere and IcoSphere.

Depth

Sets the starting length for Cylinder and Cone.

Note about planar primitives

You can make a planar mesh three-dimensional by moving one or more of the vertices out of its plane (applies to Plane, Circle and Grid). A simple circle is actually often used as a starting point to create even the most complex of meshes.

Options

Plane

A standard plane contains four vertices, four edges, and one face. It is like a piece of paper lying on a table; it is not a real three-dimensional object because it is flat and has no thickness. Objects that can be created with planes include floors, tabletops, or mirrors.

Cube

A standard cube contains eight vertices, twelve edges, and six faces, and is a real three-dimensional object. Objects that can be created out of cubes include dice, boxes, or crates.

Circle

A standard circle is comprised of n vertices. The number of vertices and radius can be specified in the context panel in the Tool Shelf which appears when the circle is created. When Fill button is active, the circle will be filled with triangular faces which share a vertex in the middle. However the circle is only a flat shape. If it is not filled and you want to render it, you must assign it a wireframe material to it in the material menu. The Radius parameter adjusts the size of the circle.

The more vertices the circle contains, the smoother its contour will be, see (*"Circles" obtained with various settings*). In contrast, a circle with only 3 vertices, is actually a triangle — the circle is actually the standard way of adding a polygons such as triangles, pentagons, etcetera.

UV Sphere

A standard UV sphere is made out of n segments and m rings. The level of detail and radius can be specified in context panel in the Tool Shelf which appears when the UV sphere is created. Increasing the number of segments and rings makes the surface of the UV sphere smoother. Segments are like Earth's meridians, going pole to pole and Rings are like Earth's parallels.

Example objects that can be created out of UV spheres are balls, heads or pearls for a necklace.

Note

If you specify a six segment, six ring UVsphere you'll get something which, in top view, is a hexagon (six segments), with five rings plus two points at the poles. Thus, one ring fewer than expected, or one more, if you count the poles as rings of radius 0.

Icosphere

An icosphere is a sphere made up of triangles. The number of subdivisions and radius can be specified in the context panel in the Tool Shelf when the Icosphere is created; increasing the number of subdivisions makes the surface of the Icosphere smoother. At level 1 the Icosphere is an icosahedron, a solid with 20 equilateral triangular faces. Any increasing level of subdivision splits each triangular face into four triangles, resulting in a more spherical appearance. Icospheres are normally used to achieve a more isotropical and economical layout of vertices than a UV sphere.

Note

It is possible to add an icosphere subdivided 500 times. Adding such a dense mesh is a sure way to cause a program crash. An icosphere subdivided 10 times would have 5,242,880 triangles, so be very careful about this!

Cylinder

A standard cylinder is made out of n vertices. The number of vertices in the circular cross-section can be specified in the context panel in the Tool Shelf that appears when the object is created; the higher the number of vertices, the smoother the circular cross-section becomes. The Radius and Depth parameters controls dimensions of cylinder. Objects that can be created out of cylinders include handles or rods.

If Cap Ends is inactive, the created object will be a tube. Objects that can be created out of tubes include pipes or drinking glasses (the basic difference between a cylinder and a tube is that the former has closed ends).

Cone

A standard cone is made out of n vertices. The number of vertices in the circular base, dimensions and option to close the base of cone can be specified in the context panel in the Tool Shelf that appears when the object is created; the higher the number of vertices, the smoother the circular base becomes. Objects that can be created out of cones include spikes or pointed hats.

Torus

A doughnut-shaped primitive created by rotating a circle around an axis. The overall dimensions are defined by the Major and Minor Radius. The number of vertices (in segments) can be different for the circles and is specified in context panel in the Tool Shelf with both radii (Major Segments and Minor Segments).

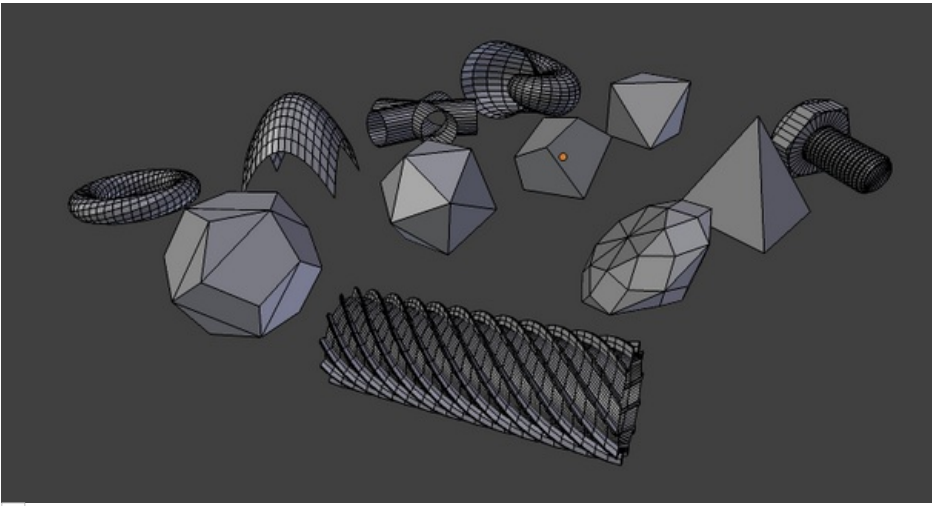
Grid

A standard grid is made out of n by m vertices. The resolution of the x-axis and y-axis can be specified in the context panel in the Tool Shelf which appears when the object is created; the higher the resolution, the more vertices are created. Example objects that can be created out of grids include landscapes (with the proportional editing tool or Displace modifier) and other organic surfaces. You can also obtain a grid when you create a plane and then use a subdivide modifier in Edit mode. However, there is a Landscape add-on available in the User Preferences.

Monkey

This is a gift from old NaN to the community and is seen as a programmer's joke or "Easter Egg". It creates a monkey's head once you press the Monkey button. The Monkey's name is "Suzanne" and is Blender's mascot. Suzanne is very useful as a standard test mesh, much like the [Utah Tea Pot](#) or the [Stanford Bunny](#).

Add-ons



A few of the mesh primitives available as add-ons.

In addition to the basic geometric primitives, Blender has a constantly increasing number of script generated meshes to offer as pre-installed add-ons. These become available when enabled in the User Preferences' Add-ons section (filter by Add Mesh). Only a few are mentioned here:

Landscape

Adds a landscape primitive. Many parameters and filters appear in the Tool Shelf.

Pipe Joints

Adds one of five different pipe joint primitives. Radius, angle, and other parameters can be changed in the Tool Shelf.

Gears

Adds a gear or a [worm](#) with many parameters to control the shape in the Tool Shelf.

Page status ([reviewing guidelines](#))

Proposed split

Text like 2.4

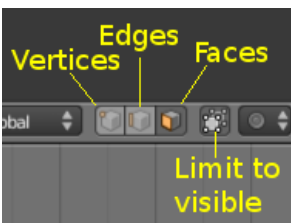
Proposed fixes: none

Selecting Mesh Components

There are many ways to select elements, and it depends on what Mesh Select Mode you are in as to what selection tools are available. First we will go through these modes and after that a look is taken at basic selection tools.

Selection Modes

Select Mode Header Widgets



Edit mode selection buttons

In Edit mode there are three different selection modes. You can enter the different modes by selecting one of the three buttons in the toolbar.

Using the buttons you can also enter **mixed mode** by \uparrow Shift LMB  clicking the buttons.

Vertices

Selected vertices are drawn in orange, unselected vertices in black, and the active or last selected vertex in white.

Edges

In this mode the vertices are not drawn. Instead the selected edges are drawn in orange, unselected edges black, and the active or last selected edge in white.

Faces

In this mode the faces are drawn with a selection point in the middle which is used for selecting a face. Selected faces and their selection point are drawn in orange, unselected faces are drawn in black, and the active or last selected face is highlighted in white.

Almost all modification tools are available in all three mesh selection modes. So you can Rotate, Scale, Extrude, etc. in all modes. Of course rotating and scaling a *single* vertex will not do anything useful, so some tools are more or less applicable in some modes.

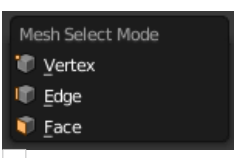
Note

The “Mode Selection” buttons are only visible in Edit mode

Select Mode Pop-up

Mode: Edit mode

Hotkey: Ctrl \leftrightarrow Tab



Mesh Select Mode menu

You can also choose a selection mode with the pop-up menu

Select Mode » Vertices

Press Ctrl⇧ Tab and select Vertices from the pop-up menu, or press Ctrl⇧ Tab1.

Select Mode » Edges

Press Ctrl⇧ Tab and select Edges from the pop-up menu, or press Ctrl⇧ Tab2.

Select Mode » Faces

Press Ctrl⇧ Tab and select Faces from the pop-up menu, or press Ctrl⇧ Tab3.

Switching Selection Mode

When switching selection modes, from Vertices to Edges and from Edges to Faces, the selected parts will still be selected if they form a complete set in the new selection mode. For example, if all four edges in a face are selected, switching from Edges mode to Faces mode will keep the face selected. All selected parts that do not form a complete set in the new mode will be unselected.

Selected elements after switching select mode

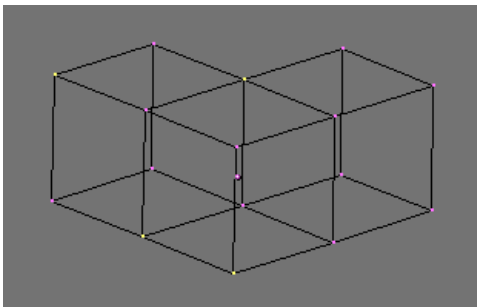
When switching modes in an “ascendant” way (i.e. from simpler to more complex), from Vertices to Edges and from Edges to Faces, the selected parts will still be selected if they form a complete element in the new mode.

For example, if all four edges in a face are selected, switching from Edges mode to Faces mode will keep the face selected. All selected parts that do not form a complete set in the new mode will be unselected.

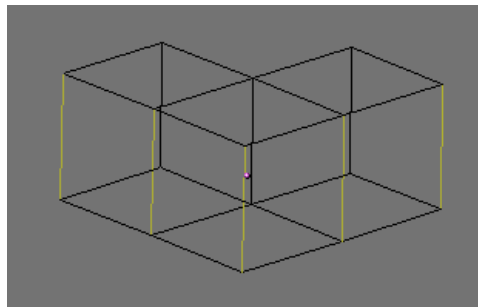
Hence, switching in a “descendant” way (i.e. from more complex to simpler), all elements defining the “high-level” element (like a face) will be selected (the four vertices or edges of a quadrangle, for example).

By holding Ctrl when selecting a higher selection mode, all elements touching the current selection will be added, even if the selection does not form a complete higher element.

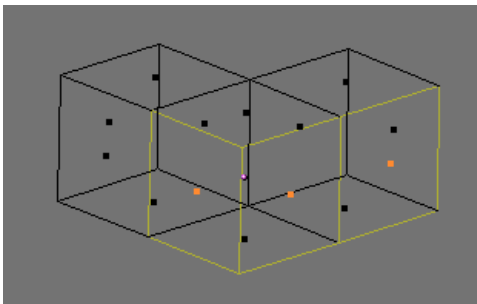
See (*Vertices mode example*), (*Edges mode example*), (*Faces mode example*) and (*Mixed mode example*) for examples of the different modes.



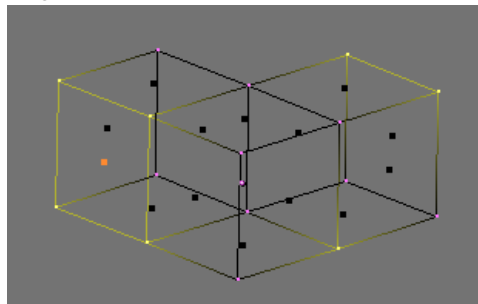
Vertices mode example.



Edges mode example.



Faces mode example.



Mixed mode example.

Basic Selection

Mode: Edit mode

Hotkey: RMB  and ⇧ Shift RMB 

The most common way to select an element is to RMB  on that item, this will replace the existing selection with the new item.

Adding to a Selection

To add to the existing selection hold down ⇧ Shift while right clicking. Clicking again on a selected item will de-select it.

As in Object mode, there is a unique *active* element, displayed in a lighter shade (in general, the last element selected). Depending on the tools used, this element might be very important!

Note that there is no option to choose what element to select between overlapping ones (like the Alt RMB click in Object mode). However, if you are in solid, shaded, or textured viewport shading mode (not bounding box or wireframe), you will have a fourth button that looks like a cube, just right to the select mode ones.

When enabled, this limits your ability to select based on visible elements (as if the object was solid), and prevents you from accidentally selecting, moving, deleting or otherwise working on backside or hidden items.

Selecting Elements in a Region

Mode: Edit mode

Hotkey: B, BB, and Ctrl LMB click and drag

Region selection allows you to select groups of elements within a 2D region in your 3D view. The region can be either a circle or rectangle. The circular region is only available in Edit mode. The rectangular region, or "*Border Select*", is available in both Edit mode and Object mode.

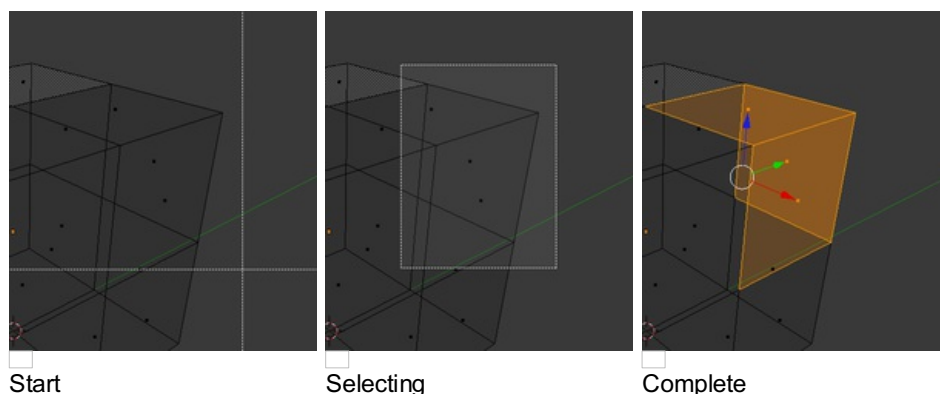
Note
What is selected using both these tools is affected by the Limit Selection to visible feature (available under the 3D viewport) in Solid Viewport Shading Mode.

For example,

1. in solid shading mode and face selection mode, all faces *within* the selection area will be selected;
2. whilst in the wireframe shading mode and face selection mode, only faces whose handle are within the selection area will be selected.

Rectangular region (Border select)


Border Select is available in either Edit mode or Object mode. To activate the tool use the B. Use Border Select to select a group of objects by drawing a rectangle while holding down LMB. In doing this you will select all objects that lie within or touch this rectangle. If any object that was last active appears in the group it will become selected *and* active.



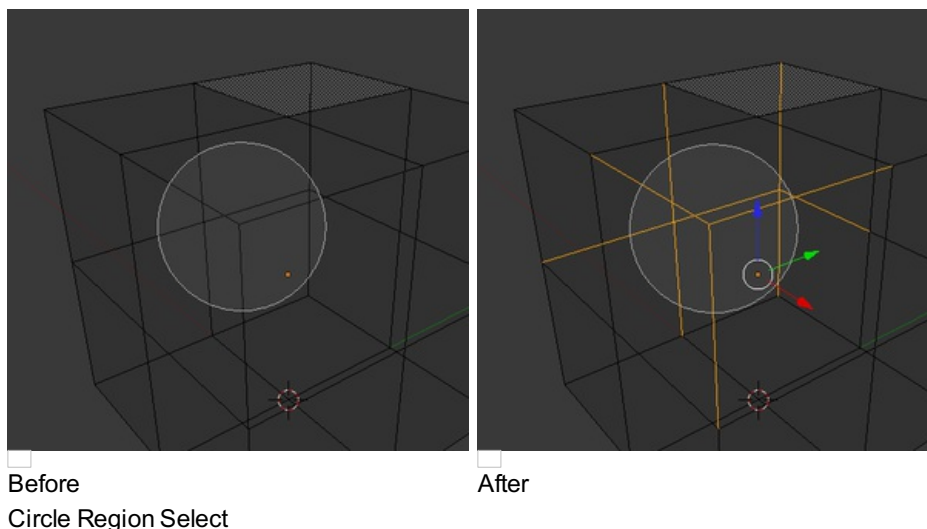
In (*Start*), Border Select has been activated and is indicated by showing a dotted cross-hair cursor. In (*Selecting*), the *selection region* is being chosen by drawing a rectangle with the LMB. The selection area is only covering the selection handles of three faces. Finally, by releasing LMB the selection is complete; see (*Complete*).


Note
Border select adds to the previous selection, so in order to select only the contents of the rectangle, deselect all with A first. In addition, you can use MMB while you draw the border to deselect all objects within the rectangle.

Circular region

This selection tool is only available in Edit mode and can be activated with C. Once in this mode the cursor changes to a dashed cross-hair with a 2D circle surrounding it. The tool will operate on whatever the current select mode is. Clicking or dragging with the LMB , when elements are inside the circle, will cause those elements to be selected.

You can enlarge or shrink the circle region using + NumPad and - NumPad, or the Wheel .



(*Circle Region Select*) is an example of selecting edges while in Edge Select Mode. As soon as an edge intersects the circle the edge becomes selected. The tool is interactive such that edges are selected while the circle region is being dragged with the LMB .


If you want to de-select elements either hold MMB  or Alt LMB  and begin clicking or dragging again.

For Faces select mode, the circle must intersect the face indicators usually represented by small pixel squares; one at the center of each face.

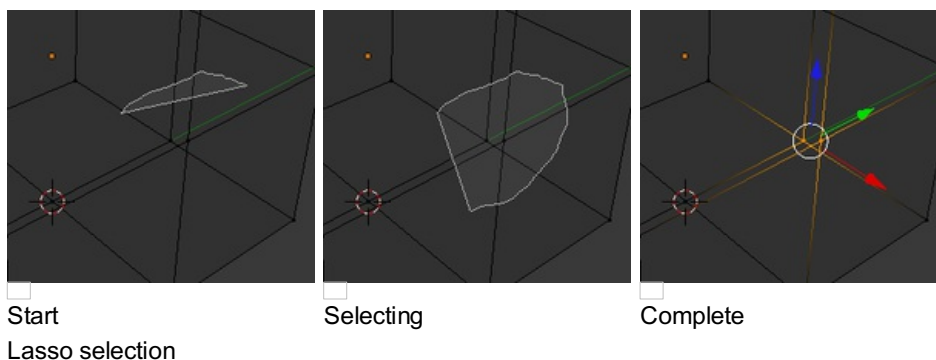
To exit from this tool click RMB , or hit the Esc key.

Lasso region

Lasso select is similar to Border select in that you select objects based on a region, except Lasso is a hand-drawn region that generally forms a circular/rounded shaped form; kind of like a lasso.

Lasso is available in either Edit Mode or Object Mode. To activate the tool use the Ctrl LMB  while dragging. The one difference between Lasso and Border select is that in Object mode, Lasso only selects objects where the lasso region intersects the objects centre.

To de-select use Ctrl⇧ Shift LMB  while dragging.



(*Lasso selection*) is an example of using the Lasso select tool in Vertex Select Mode.

Additional Selection Tools

The select menu in edit mode contains additional tool for selecting components:

Basic Tools

Select All/Select None A

Select all or none of the mesh components.

Invert Selection Ctrl

Selects all components that are not selected, and deselect currently selected components.

More CtrlNum+

Propogates selection by adding components that are adjacent to selected elements.

Less CtrlNum-

Deselects components that form the bounds of the current selection

Advanced Tools

Mirror

Select mesh items at the mirrored location.

Linked CtrlL

Selects all components that are connected to the current selection.

Select Random

Selects a random group of vertices, edges, or faces, based on a percentage value.

Select Every N Number of Vertices

Selects vertices that are multiples of N.

Select Sharp Edges

This option will select all edges that are between two faces forming an angle less than a given value, which is asked you *via* a small pop-up dialog. The lower is this angle limit, the sharper will be the selected edges. At **180°**, **all** “manifold” (see below) edges will be selected.

Linked Flat Faces (Ctrl⇧ ShiftAltF)

Select connected faces based on a threshold of the angle between them. This is useful for selecting faces that are planar.

Select Non Manifold (Ctrl⇧ ShiftAltM)

Selects vertices that are not completely bound by geometry, including border edges, floating edges, and orphan vertices. Only available in Vertex mode.

Interior

Select faces where all edges have more than 2 faces.

Side of Active

Selects all data on the mesh in a single axis

Tris

Select all triangles in the mesh

Quads

Select all quads in the mesh

Loose

Select all vertices or edges that do not form part of a face.

Select Similar

Mode: Edit mode

Hotkey: ⇧ ShiftG

Menu: Select » Similar to Selection...

Select components that have similar attributes to the ones selected, based on a threshold that can be set in tool properties after activating the tool. Tool options change depending on the selection mode

Vertex Selection Mode

Normal

Selects all vertices that have normals similar to those currently selected.

Amount of Vertices in Face

Selects all vertices that belong to exactly the same number of faces as those already selected. For example, assuming you have only one selected vertice, if this one does not belong to any face, this option will select all vertices not involved in faces.

Vertex Groups

Selects all vertices sharing one or more [vertex groups](#) with those already selected.

Edge Selection Mode

Length

Selects all edges that have a similar length as those already selected.

Direction

Selects all edges that have a similar direction (angle) as those already selected.

Amount of Vertices in Face

Selects all edges that belong to exactly the same number of faces as those already selected. This is the same as for Vertex select mode described above.

Face Angles

Selects all edges that are between two faces forming a similar angle, as with those already selected.

Crease

Selects all edges that have a similar Crease value as those already selected. The Crease value is a setting used by the [Subsurf Modifier](#).

Seam

Selects all edges that have the same Seam state as those already selected. Seam is a two-states setting used in [UV-texturing](#).

Sharpness

Selects all edges that have the same Sharp state as those already selected. Sharp is a two-state setting (a flag) used by the [EdgeSplit Modifier](#).

Face Selection Mode

Material

Selects all faces that use the same material as those already selected.

Image

Selects all faces that use the same UV-texture as those already selected (see [UV-texturing](#) pages).

Area

Selects all faces that have a similar area as those already selected.

Perimeter

Selects all faces that have a similar perimeter as those already selected.

Normal

Selects all faces that have a similar normal as those selected. This is a way to select faces that have the same orientation (angle).

Co-planar

Selects all faces that are (nearly) in the same plane as those selected.

Selecting Loops

You can easily select loops of components:

Edge Loop and Vertex Loop Selection

Mode: Edit mode → Vertex or Edge select mode

Hotkey: Alt RMB  or CtrlE → Select » Edge Loop

Menu: Select » Edge Loop or Mesh » Edges » Edge Loop

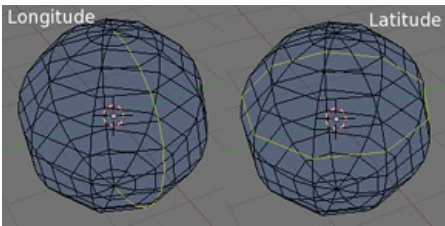
Holding Alt while selecting an edge selects a loop of edges that are connected in a line end to end, passing through the edge under the mouse pointer. Holding Alt+Shift while clicking adds to the current selection.

Edge loops can also be selected based on an existing edge selection, using either Select » Edge Loop, or the Edge Loop Select option of the Edge Specials menu (CtrlE).

Vertex mode

In Vertex select mode, you can also select edge loops, by using the same hotkeys, *and clicking on the edges* (not on the vertices).

Example



Longitudinal and latitudinal edge loops.

The left sphere shows an edge that was selected longitudinally. Notice how the loop is open. This is because the algorithm hit the vertices at the poles and terminated because the edge at the pole connects to more than three other edges. However, the right sphere shows an edge that was selected latitudinally and has formed a closed loop. This is because the algorithm hit the first edge that it started with.

Face Loop Selection

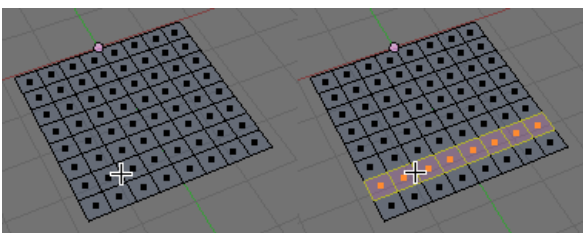
Mode: Edit mode → Face or Vertex select modes

Hotkey: Alt RMB 


In face select mode, holding Alt while selecting an **edge** selects a loop of faces that are connected in a line end to end, along their opposite edges.

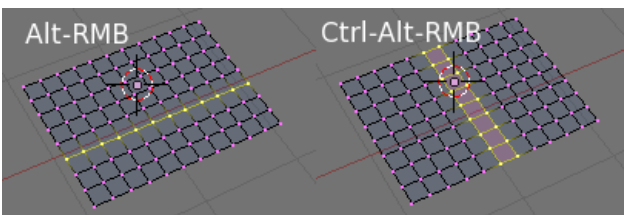
In vertex select mode, the same can be accomplished by using CtrlAlt to select an edge, which selects the face loop implicitly.

Examples



Face loop selection.

This face loop was selected by clicking with Alt RMB  on an edge, in face select mode. The loop extends perpendicular from the edge that was selected.



Alt versus CtrlAlt in vertex select mode.

A face loop can also be selected in Vertex select mode, see (*Alt versus CtrlAlt in vertex select mode*). The edges selected in the grid labeled “Alt-RMB” is a result of selecting an edge loop versus selecting an edge ring. Because in vertex select mode, selecting opposite edges of a face implicitly selects the entire face, the face loop has been selected implicitly.

Note that in these cases the generated result of the algorithm was *vertices* because we were in Vertex select mode. However, had we had been in Edge select mode, the generated result would have been selected edges.

Edge Ring Selection

Mode: Edit mode → Edge select mode

Hotkey: CtrlAlt RMB  or CtrlE → Select » Edge Ring

Menu: Select » Edge Ring or Mesh » Edges » Edge Ring

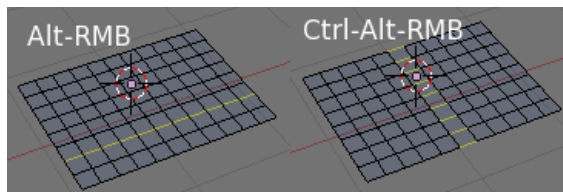
In Edge select mode, holding CtrlAlt while selecting an edge selects a sequence of edges that are not connected, but on opposite sides to each other continuing along a [face loop](#).

As with edge loops, you can also select edge rings based on current selection, using either Select » Edge Ring, or the Edge Ring Select option of the Edge Specials menu (CtrlE).

Vertex mode

In Vertex select mode, you can use the same hotkeys when *clicking on the edges* (not on the vertices), but this will directly select the corresponding face loop...

Example



A selected edge loop, and a selected edge ring.

In (*A selected edge loop, and a selected edge ring*), the same edge was clicked on but two different “groups of edges” were selected, based on the different commands. One is based on edges during computation and the other is based on faces.

Loop to Region and Region to Loop

Mode: Edit mode → Edge select mode

Hotkey: CtrlE » 9 NumPad and CtrlE → Select » Loop to Region/Region to Loop

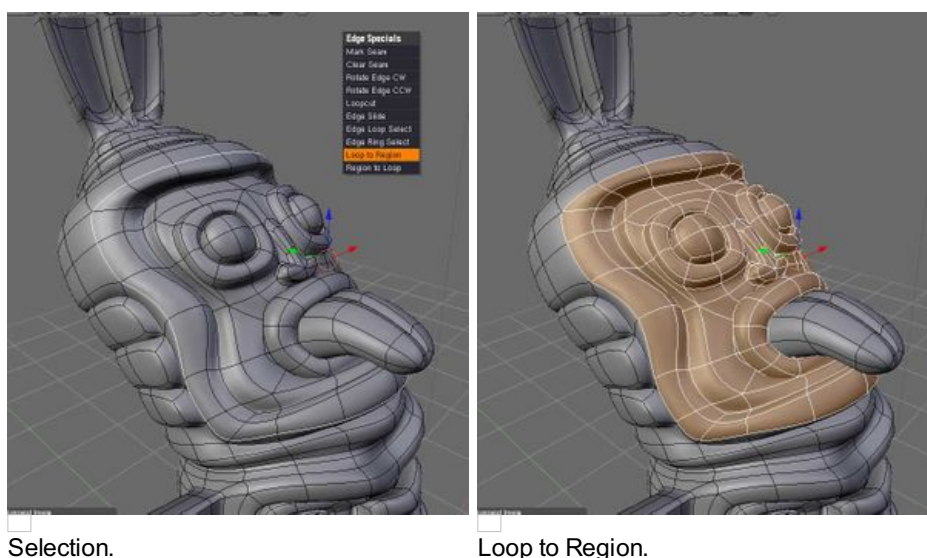
Menu: Select » Loop to Region/Region to Loop or Mesh » Edges » Loop to Region/Region to Loop

Loop to Region examines the current set of selected edges and separates them into groups of “loops” that each bisect the mesh into two parts. Then for each loop it selects the smaller “half” of the mesh. Even though it works in Vertex and Face select mode, the results using these might be strange – you should stick to Edge select mode...

Region to Loop is the “logical inverse” of Loop to Region, based on all regions currently selected, it selects only the edges at the border of these regions. It can operate in any select mode, but always switch in Edge select mode when applied.

All this is much more simple to illustrates with examples:

Example: Loop to Region

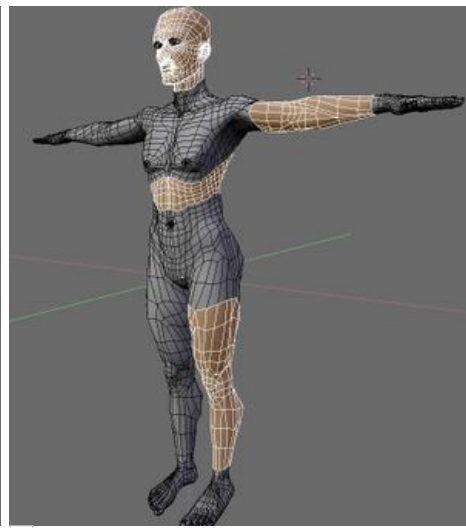


Selection.

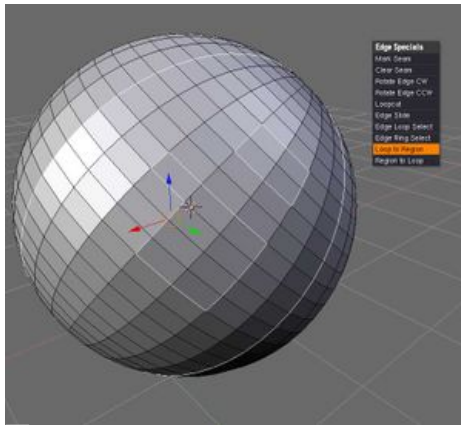
Loop to Region.



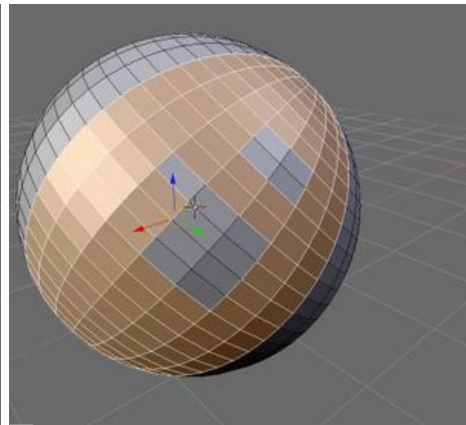
Selection.



This tool handles multiple loops fine, as you can see.

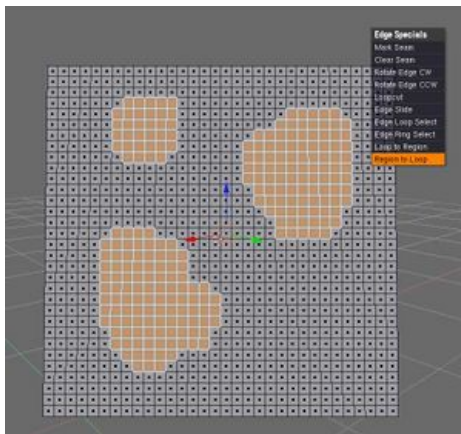


Selection.

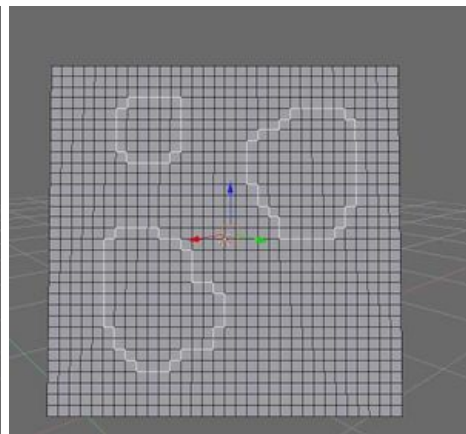


This tool handles "holes" just fine as well.

Example: Region to Loop



Selection.



This is the "logical inverse" of loop to region.

Selectable Elements

As we have seen in the [mesh structure page](#), meshes are made of different element types (even though they are all inter-related: in a way, they are different “views”, “representations”, of the same basic data...), “vertices”, “edges” and “faces”.

Hence, you can select different parts in a mesh using one of this three types. There is one key point to understand here: *when you select a type of elements (e.g. some edges), you **implicitly** select the other types of corresponding elements (e.g. all vertices defining those edges, as well as faces fully defined by these same edges)*. This is very important, as some tools only work on vertices, edges and/or faces: if you use a “face” tool with a selection of vertices, only the faces defined by these vertices will be affected.

In general, you will only select one type of element at a time, depending on the “select mode” you are using. However, you can successively add different elements to a same selection, switching between these select modes (see [below](#) for what is selected after switching select mode), or even use a “combined” select mode, also described below.

Select Modes

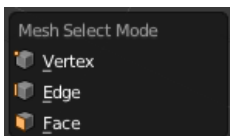
You have two ways to switch between select modes:

Select Mode popup

Mode: Edit mode

Hotkey: Ctrl⇧ Tab

In Edit mode there are three different select modes for meshes, see (*Select Mode menu*).



Select Mode menu.

Select Mode » Vertices

Press Ctrl⇧ Tab and select Vertices from the popup menu, or press Ctrl⇧ Tab1 NumPad. The selected vertices are drawn in yellow and unselected vertices are drawn in a pink colour.

Select Mode » Edges

Press Ctrl⇧ Tab and select Edges from the popup menu, or press Ctrl⇧ Tab2 NumPad. In this mode the vertices are not drawn. Instead the selected edges are drawn in yellow and unselected edges are drawn in a black colour.

Select Mode » Faces

Press Ctrl⇧ Tab and select Faces from the popup menu, or press Ctrl⇧ Tab3 NumPad. In this mode the faces are drawn with a selection point in the middle which is used for selecting a face. Selected faces are drawn in yellow with the selection point in orange, unselected faces are drawn in black.

Almost all modification tools are available in all three modes. So you can Rotate, Scale, Extrude, etc. in all modes. Of course rotating and scaling a *single* vertex will not do anything useful, so some tools are more or less applicable in some modes.

Select Mode header widgets

Mode: Edit mode

Panel: Header of the 3D View



Edit mode select mode buttons.

You can also enter the different modes by selecting one of the three buttons in the toolbar; see (*Edit mode select buttons*).

Using the buttons you can also enter “**mixed**” or “combined” mode by ⇧ Shift LMB clicking the buttons. This will allow you to select vertices, edges and/or faces at the same time!

Note

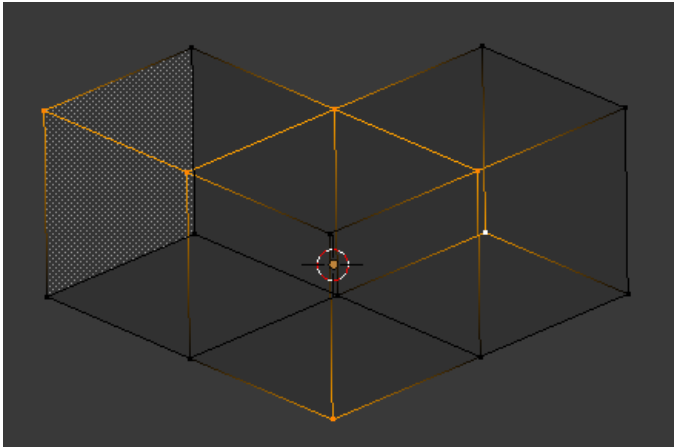
The “Mode Selection” buttons are only visible for meshes in Edit mode.

Selected elements after switching select mode

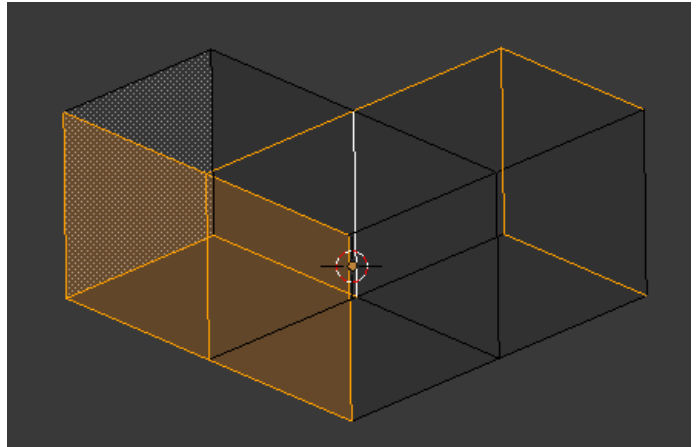
When switching modes in an “ascendant” way (i.e. from simpler to more complex), from Vertices to Edges and from Edges to Faces, the selected parts will still be selected if they form a complete set in the new mode. For example, if all four edges in a face are selected, switching from Edges mode to Faces mode will keep the face selected. All selected parts that do not form a complete set in the new mode will be unselected.

Hence, switching in a “descendant” way (i.e. from more complex to simpler), all elements defining the “high-level” element (like a face) will be selected (the four vertices or edges of a quadrangle, for example).

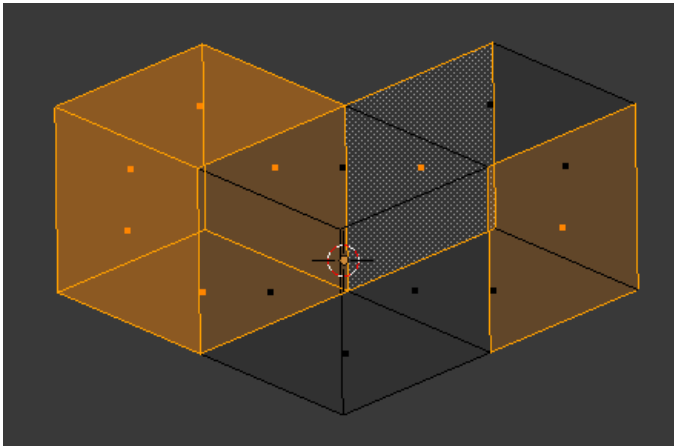
See (*Vertices mode example*), (*Edges mode example*), (*Faces mode example*) and (*Mixed mode example*) for examples of the different modes.



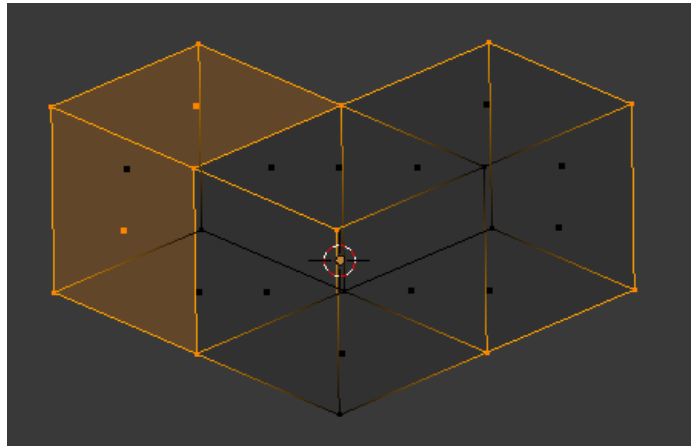
none Vertices mode example.



Edges mode example.



Faces mode example.



Mixed mode example.

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Proposed fixes: none

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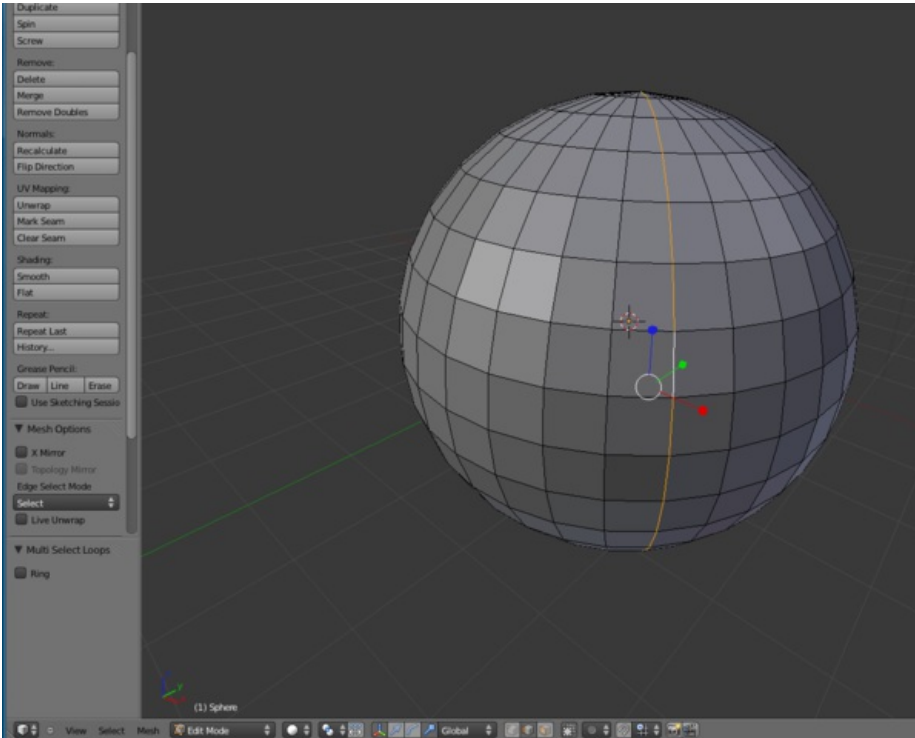
Proposed fixes: none

Selecting Edges

Edges can be selected in much the same way as vertices and faces- by right clicking them while edge mode is on.

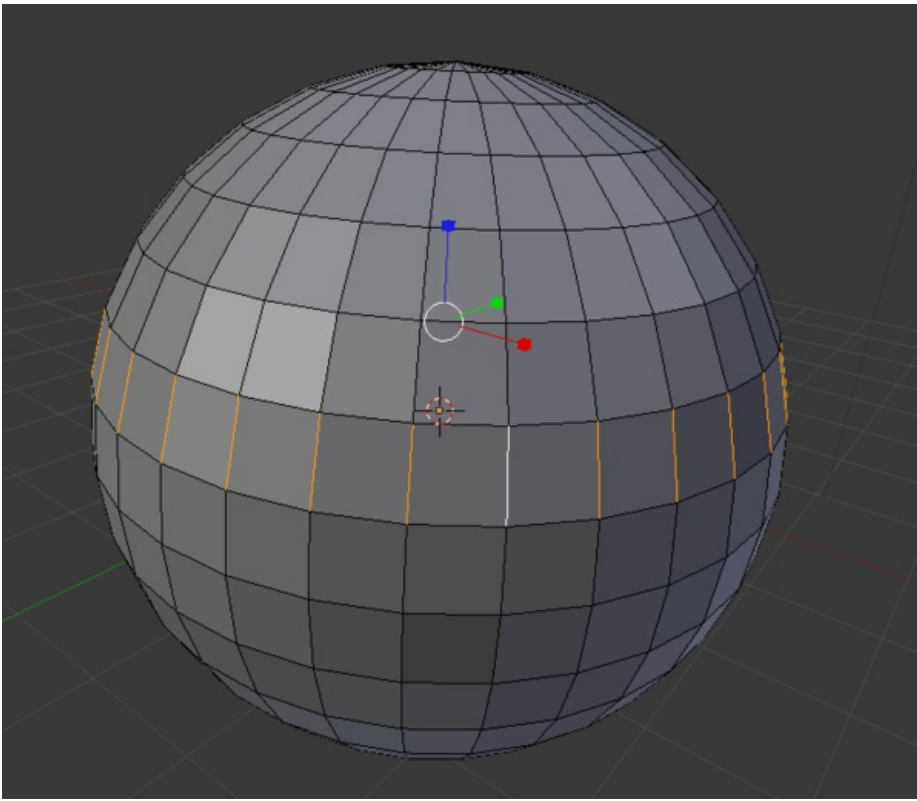
Edge Loops

Edge loops can be selected by selecting an edge or two vertices, and going Select>Edge Loop



Edge Rings

Edge Rings are selected similarly.



What if you want to select the faces inside an edge ring (not edge loops, as there are not faces inside and edge loop). If you go to face mode after an edge ring selection, you will see nothing is selected. Why? Because none of those faces had all its (four) edges selected, just two of them. You would need to select the upper and lower edge of each one of those faces (that could be done selecting its upper and lower edge loop).

However there is an easier way: just after you have selected the edge ring, go to vertex mode. Now each one of the selected edges translates into two selected vertices, meaning that now all four vertices of the desired faces are selected. That's all the information Blender has: the four vertices are selected, no information about which edges were selected or unselected. That means that if you go back to edge mode, that vertex selection will be translated into all edges between them, so now all those desired edges will be selected; or if you go to face mode, you will see actually those faces properly selected.

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Proposed fixes: none

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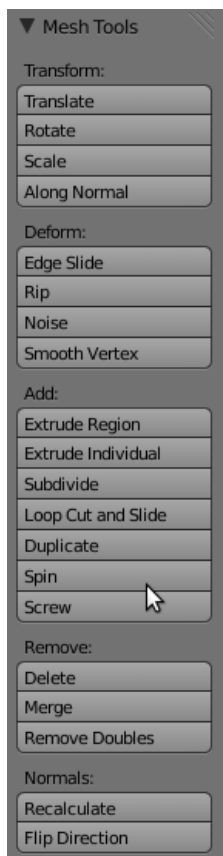
Mesh Editing

Blender provides a variety of tools for editing meshes. These are available through the Mesh Tools palette, the Mesh menu in the 3d view header, and context menus in the 3d view, as well as individual shortcut keys.

Note that all the “transform precision/snap” keys (Ctrl and/or ⇧ Shift) work also for all these advanced operations... However, most of them do not have [axis locking](#) possibilities, and some of them do not take into account [pivot point](#) and/or [transform orientation](#) neither...

These transform tools are available in the Transform section of the Mesh menu in the menu bar. Note that some of these can also be used on other editable objects, like curves, surfaces, and lattices.

Types of Tools



Mesh Tools

The mesh tools are found in various places, and available through shortcuts as well.

[Transform and Deform tools:](#)

- Translate
- Rotate
- Scale
- Mirror
- Shrink/Flatten/Along Normal
- Push/Pull
- To Sphere
- Shear
- Warp
- Edge Slide
- Noise
- Smooth Vertex
- Edge Flip
- Rotate Edge

[Add and Divide tools:](#)

- Make Edge/Face
- Fill
- Beauty Fill
- Solidify
- Quads to Tris
- Extrude Region
- Extrude Individual
- Subdivide
- Loop Cut/Slide
- Knife tool
- Duplicate
- Spin
- Screw

[Merge and Remove tools:](#)

- Delete
- Merge

[Separate tools:](#)

- Rip
- Split
- Separate

- Remove Doubles
- Tris to Quads
- Separate

Accessing Mesh Tools

Mesh Tools Palette

When you select a mesh and ⇌ Tab into edit mode, the Tool Shelf changes from Object Tools to Mesh Tools. These are only some of the mesh editing tools.

Menus

The Mesh is located in the Header bar. Some of the menus can be accessed with shortcuts:

CtrlF brings up the Face tool menu

CtrlE brings up the Edge tool menu

CtrlV brings up the Vertex tool menu

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Transforming and Deform

These tools simply move existing mesh components in different ways.

Transform Tools

Move, Rotate, Scale

To move, rotate and scale selected components, either use the Translate, Rotate, and Scale buttons, the [transform manipulators](#), or the shortcuts:


G, R, and S respectively.

When you do, the lower part of the Tool Shelf is changed into a tool-specific panel (i.e. a Resize panel is displayed when a selection of components have been scaled.) You can use this panel to fine-tune your changes, limit the effect to certain axes, turn proportional editing on and off, etc.

Mirror

To Mirror geometry, use the shortcut CtrlM



After this tool becomes active, select an axis to mirror the selection on entering x,y, or z.

You can also interactively mirror the geometry by holding the MMB  and dragging in the direction of the desired mirror direction.

Edge Slide

Edge Slide (CtrlE » Edge Slide)

Slides one or more edges across adjacent faces with a few restrictions involving the selection of edges (i.e. the selection must make sense, see below.)

LMB  confirms the tool, and RMB  or Esc cancels.

This tool has a factor, which is displayed in the 3D View footer and in the Tool Shelf (after confirmation). A numerical value between -1 and 1 can be entered for precision.

Edge Flipping

Edge Flip ⇧ ShiftCtrlF

Select two adjacent tris then use this tool to flip the shared edge to the opposite corners

Rotate Edge CtrlE >> rotate edge CW/CCW

With an edge selected, or two adjacent faces, use this tool to rotate the shared edge inside the group of edges.

Deforming Geometry

Shrink/Flatten

A selection of vertices can be shrunken and flattened along their normals using the Along Normals button, or the shortcut AltS.

Push/Pull

Similar to shrink/flatten, this transformation consists in translating all selected elements along the line joining their original position to the Average position of the points. All translations are of same value, and controlled by the mouse. It gives something that reminds a bit the scale effect, but much more deforming.

Note that unlike the preceding ones, you can [lock](#) this transformation on axis – even though this has no real interest (except perhaps with a “plane locking”...).

Warp

Mode: Edit mode

Hotkey: ⇧ ShiftW

Menu: Mesh/Curve/Surface » Transform » Warp

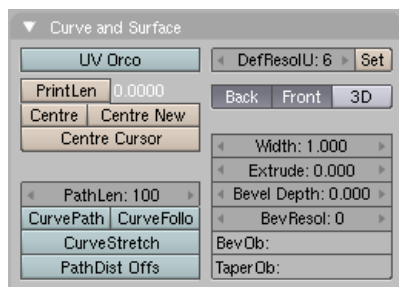
The Warp transformation is useful in very specific cases. It works by warping the selected elements around the 3D cursor (always the 3D cursor, it does not take into account the pivot point setting...). It is also view dependent. The points that line up vertically with the cursor will remain in place. Each point's distance to the cursor's **horizontal position** corresponds to the radius it will be from the cursor after the tool has been activated. The tool will then wrap the point around the cursor. A value of 360 will wrap the mesh into a complete circle, so that the points furthest to the left and the right will line up with each other and the cursor position.

To use this tool, set the cursor in the view where the center should be. Activate the tool, then move the cursor or enter the value of the angle the mesh should be warped to.

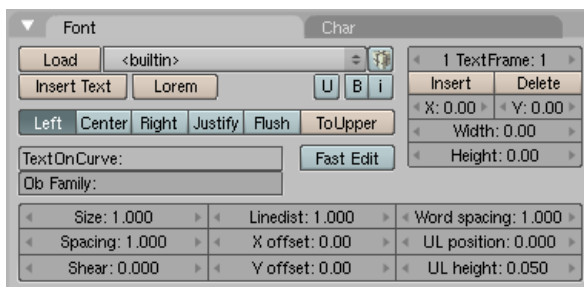
Example

A piece of text wrapped into a ring shape is useful when creating flying logos, but it would be difficult to model without the use of the warp tool. For our example, we'll warp the phrase "Amazingly Warped Text" around a sphere.

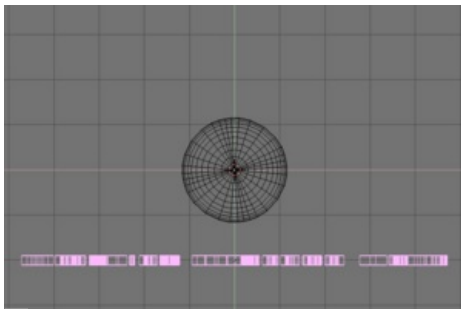
- First add the sphere.
- Then add the text in front view, in the Editing context and [Curve and Surface panel](#) set Extrude to 0.1 – making the text 3D, and set Bevel Depth to 0.01, adding a nice bevel to the edge. Make the Bevel Resol 1 or 2 to have a smooth bevel and lower the resolution so that the vertex count will not be too high when you subdivide the object later on using (*Curve and Surface panel*) and (*Font panel*).
- Convert the object to curves, then to a mesh (AltC twice), because the warp tool does not work on text or on curves.
- Subdivide the mesh twice (W » Subdivide Multi » 2), so that the geometry will change shape cleanly, without artifacts.



[Curve and Surface panel.](#)

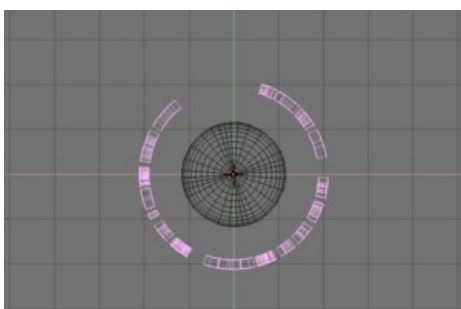


[Font panel.](#)



Top view of text and sphere.

- Switch to top view and move the mesh away from the 3D cursor. This distance defines the radius of the warp. See (*Top view of text and sphere*).



Warped text.

- Place the mesh in Edit mode (\leftarrow Tab) and press A to select all vertices. Press \diamond ShiftW to activate the warp transform tool. Move the mouse left or right to interactively define the amount of warp (*Warped text*).



Final rendering.

Now you can switch to camera view, add materials, lights and render (*Final rendering*).



Shear

Mode: Edit mode

Hotkey: CtrlAlt \diamond ShiftS

Menu: Object/Mesh/Curve/Surface » Transform » Shear

The Shear transformation applies a shearing on your selection of elements (in Edit mode, vertices/edges/control points/...). As the other transform tools, it uses the view space, and is centered on the pivot point: the shear occurs along the view's x-axis passing through the pivot point. Everything that is "above" this axis (i.e. has a positive y-axis position) will move (shear) in the same direction as your mouse pointer (but always parallel to x-axis). And everything that is "below" this x-axis will move in the opposite direction. The further away from the x-axis is an element, the more it moves.

When the tool becomes active, move the mouse left to right to interactively control the shearing. To make the effect work on the vertical axis instead of the horizontal one, click the MMB  and then move the mouse up or down. Alternatively enter a numerical value from 0 to infinity. To finish the tool, press the LMB .

To Sphere

Mode: Edit modes

Panel: Mesh Tools (Editing context, F9)

Hotkey: \diamond ShiftAltS

Menu: Mesh/Curve/Surface » Transform » To Sphere

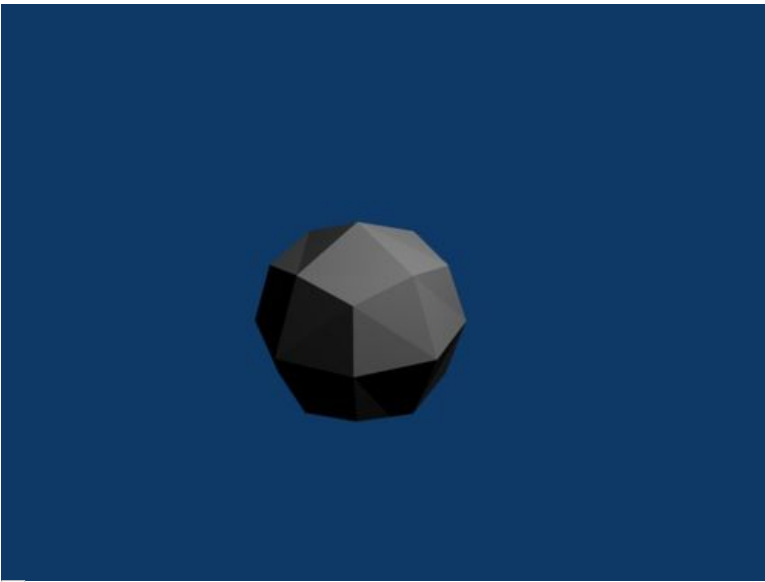
This command "spherifies" the selected mesh elements. It does this by finding the average position of the elements, and moves them toward the average distance they are from this point. Using a value of 1 puts all of the vertices an equal distance from this point, creating a spherical shape.

When the tool becomes active, drag the mouse left or right to interactively control the effect, or type in a value from 0 to 1 to manually control it.

Example

This tool allows the creation of spheres from subdivided cubes. First, start with a [Cube](#). Let's start with from fresh by erasing all (CtrlX).

- Press \leftarrow Tab to switch into Edit mode.
- Make sure all the vertices of the cube are selected by pressing A twice. Then, go to the Editing context by pressing F9. You should be able to see the Mesh Tools panel now.
- Subdivide the cube by pressing the Subdivide button in the Mesh Tools panel, or with W » Subdivide. You can do this as many time as you want; the more you subdivide, the smoother your sphere will be.
- Now, press \diamond ShiftAltS and move your mouse left or right to interactively control the proportion of "spherification" (or directly type a value, like "1.000" to achieve the same effect as below) – preferably using the Median Point pivot point!
- Alternatively, you can use the To Sphere button (in the Mesh Tools panel). Select "100" to make your sphere. Note that you *should not move the 3D cursor* – or you won't get a sphere, but a piece of sphere...



Finished low-res sphere!

Noise

Noise Uses the texture in the material's first texture slot as input to deform the selected vertices.

The mesh must have a material and a texture assigned to it for this tool to work. To avoid having the texture affect material's properties, it can be disabled in the texture menu.

The deformation can be controlled by modifying the Mapping panel and/or the texture's own panel (e.g. Clouds, Marble, etcetera).

Note

The [Displace Modifier](#) is a non-destructive alternative to the Noise tool.

See also the ANT Landscape [add-on](#).

Smooth

Smooth Vertex (W » Shade Smooth or 9): Smooths the selected vertices by flattening the vertices angles.

After confirmation, alternatives appear in the Tool Shelf to limit the effect to certain axes and to set the number of smooth iterations.

Note

The [Smooth modifier](#), which can be limited to a Vertex Group, is a non-destructive alternative to the smooth tool.

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Proposed fixes: none

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Proposed split

Text split delete from merge from convert

Proposed fixes: none

Delete and Merge

These tools can be used to remove components, and merge existing components together.

Delete

Delete (X or Del)

Deletes selected vertices, edges, or faces.

This operation can also be limited to:

All

Extends the operation to the entire mesh. The containing object is not deleted; allowing to restart the mesh from within the object (i.e. leaving other object properties such as materials, modifiers, and layers intact.)

This is a quick way to "export" properties from an existing mesh to a new mesh. Simply duplicate an existing mesh in object mode, say a blue cube parented to a curve and using a stack of modifiers; ⇐ Tab into edit mode, delete all vertices and add, for example, a sphere to "reuse" all the properties of the cube.

Edges & Faces

Limits the operation to only selected edges and adjacent faces.

Only Faces

Only deletes selected faces.

Edge Loop

Deletes an edge loop. If the current selection is not an edge loop, this operation does nothing.

Merge

Merge (AltM)

Merges selected vertices.

A popup menu asks for a center to merge to. Use the menu number selector to quickly select, for example First (1), Last (2), or Center (3).

Remove Doubles (W » Remove doubles or 4)

Removes all overlapping vertices in the selection.

The selected vertices don not need to be perfectly aligned. After completion, a Merge Threshold appears in the Tool Shelf which can be increased to merge more vertices.

Convert Triangles to Quads

Tris to Quads AltJ This takes adjacent tris and removes the shared edge to create a quad. This tool can be performed on a selection of multiple triangles.

This same action can be done on a selection of just 2 tris, by selecting them and using the shortcut F, to create a face.

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Proposed fixes: none

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Proposed fixes: none

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Proposed fixes: none

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Proposed fixes: none

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Proposed fixes: none

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Proposed fixes: none

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Proposed split

Text split all the function like 2.4

Proposed fixes: none

Adding and Dividing

These tools can be used to add more geometry to the current mesh.

Create Faces and Edges

Make Edge/Face F

This tool will create new geometry from a selection of faces, edges, or vertices according to the following rules:

- 2 vertices will create an edge
- 3 vertices will create a tri
- 4 vertices will make a face
- 2 edges will create a face

Fill AltF

From a selection of closed edges, this will fill the hole with tris

Beauty Fill ⇧ ShiftAltF

This takes a group of quads and tris and makes the arrangement of interior edges cleaner. Each time the tool is used, the fill is improved until no better arrangement can be found.

Duplicate

Duplicate (⇧ ShiftD)

Duplicates selected vertices and grabs them. Esc to keep the new copy at the original location.

In the Tool Shelf are settings for Vector offset, Proportional Editing, Duplication Mode (non-functional?), and Axis Constraints.

Convert Quads to Triangles

Quads to Tris CtrlT

This takes a selection of quads and triangulates them.

Extrude Tools

Extrude

Extrude Region (E or AltE » Region or 1)

Extrudes the selected vertices as a single coherent region using its common normal.

Note

The selection is extruded (1) along the common normal of selected faces or (2), when no complete face is selected, along the normal of a single selected edge. In every other case the extrusion can be limited to a single axis by specifying an axis (e.g. X to limit to the X axis or ⇧ ShiftX to the YZ plane).

When extruding along the face normal, limiting movement to the global Z axis requires pressing Z twice, once to disable the face normal Z axis limit, and once to enable the global Z axis limit.

Extrude Individual (AltE » Individual Faces or 2)

Extrudes individual faces along their respective normals.

Solidify

Solidify

This takes a selection of faces and solidifies them by extruding them uniformly to give volume to a non-manifold surface. This is also available as a modifier. After using the tool, you can set the offset distance in the Tool Palette.

Spin

Spin (AltR)

Spins selected vertices around the 3D cursor. View dependent.

The number of Steps and Degrees, as well as locations of the Center and direction of the Axis, can be set in the Tool Shelf.

Screw

Screw

Screws the selection around the 3D cursor. View dependent. The selection must be a string of connected vertices but not a loop.

Note

The Screw tool in Blender 2.5 is different from the equivalent tool in earlier versions in that it does not require an edge to define a direction.

Divide Tools

Subdivide

Subdivide (W » Subdivide or 1)

Subdivides selected edges

The number of cuts and the smoothness of the operation can be set in the Tool Shelf.

Fractal can be used to add randomness to the cut.

Several Corner Cut Patterns (Fan, Inner Vertex, and Path) produces different results for more complex edge selections.

Loop Cut



Loop Cut and Slide (CtrlR)

Adds an edge loop and slides it.

This tool has a factor, which is displayed in the 3D View footer and in the Tool Shelf (after confirmation). A numerical value between -1 and 1 can be entered for precision. Esc centers the new edge loop.

Knife Tool

Knife Tool K and ⇧ ShiftK

With a selection of edges or faces, hold K and drag the cursor with LMB  held, across edges to cut them where they intersect with the cursor. After the LMB  is released, options become available in the Tool Palette:

Type:

- Exact - Cuts once where the knife intersects the edges
- Midpoints - Cuts the midpoint of the edges that are cut
- Multicut - Cuts the edges the specified number of times, evenly.

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Proposed fixes: none

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Proposed fixes: none

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Text

wrong position
need move to vertex editing

Proposed fixes: none

Separating Geometry

These tools can be used to separate components from a mesh

Separate

SeparateP

Separate removes the components and puts them into a new object. You can set how the tool separates:

Selected

Separates selected components.

By Material

If the mesh has multiple materials assigned to it, the each will be separated into its own mesh.

All Loose Parts

If there are multiple continuous groups of mesh components in the current mesh, this will separate each into its own mesh.

Split

Split Y

Split takes the selected elements and disconnects the vertices that are shared with unselected elements.

Rip

Rip (V)

With an edge or an edge loop as input, this tool cuts a hole in the mesh along the edge selection and directly grabs the newly created edge [loop] closest to the cursor.

Note

For both the Edge Slide and Rip tool, the edge selection must make sense. The selection should not contain poles (vertices with more or less than four edges), crossing or parallel loops; or Non Manifolds (e.g. edges on the outskirts of a mesh). The most simple way to ensure a proper edge selection, is to use any of the [mesh selection tools](#) to select all edges in a single snap (e.g. ⇧ ShiftAltE.)

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Proposed fixes: none

Miscellaneous Editing Tools

Sort Elements

This tool (available from the Specials, Vertices, Edges and Faces menus) allows you to reorder the matching selected mesh elements, following various methods. Note that when called from Specials menu, the affected element types are the same as the active select modes.

View Z Axis

Sort along the active view's Z axis, from farthest to nearest by default (use Reverse if you want it the other way).

View X Axis

Sort along the active view's X axis, from left to right by default (again, there's the Reverse option).

Cursor Distance

Sort from nearest to farthest away from 3D cursor position (Reverse also available).

Material

Faces only! Sort faces from those having the lowest material's index to those having the highest. Order of faces inside each of those "material groups" remains unchanged. Note that Reverse option only reverse the order of the materials, *not* the order of the faces inside those.

Selected

Move all selected elements at the beginning (or end, if Reverse enabled), without affecting their relative orders. **Warning: this option will also affect unselected elements' indices!**

Randomize

Randomizes indices of selected elements (*without* affecting those of unselected ones). The seed option allows you to get another randomization – a same seed over a same mesh/set of selected elements will always give the same result!

Reverse

Simply reverse the order of the selected elements.

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Retopologizing

Note

In Blender 2.5, the Retopo tool has been replaced by improved mesh snapping functionality. This page will change as retopology tools are updated in newer versions of Blender

Retopology is a common part of modeling workflows. Often times, a model is created with emphasis on form and detail, however, its topology, or edge flow is not ideal, or the mesh is very dense, and not efficient. Modelers can create a new lower resolution mesh that matches the form of the original mesh.

Mesh Snapping

By enabling snapping, and setting the snap element to Face, mesh vertices will be projected onto the closest surface in the viewport, in the view's Z-axis.

This allows you to model freely, without concern for form, and to focus on topology

See [Snapping](#)

Shrinkwrap Modifier

The [Shrinkwrap Modifier](#) is useful in conjunction with face snapping. If edits to the new mesh have been made with snapping disabled, the shrinkwrap modifier will allow you to stick the new mesh to the old mesh, as if if you were shrinkwrapping it.

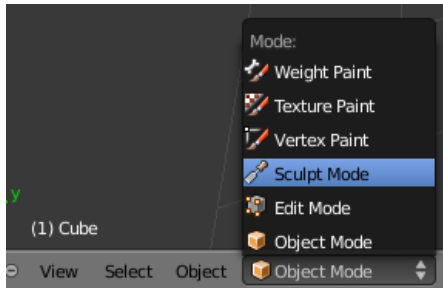
Overview

Sculpt Mode is similar to Edit Mode in that it is used to alter the shape of a model, but Sculpt Mode uses a very different workflow: instead of dealing with individual elements (vertices, edges, and faces), an area of the model is altered using a brush. In other words, instead of selecting a group of vertices, Sculpt Mode automatically selects vertices based on where the brush is, and modifies them accordingly.

Sculpt Mode

Sculpt mode is selected from the mode menu of the 3D View header.

Once sculpt mode is activated the Toolbar of the 3D View will change to sculpt mode specific panels. The panels in the toolbar will be Brush, Texture, Tool, Symmetry, Stroke, Curve, Appearance, and Options Also a red circle will appear that follows the location of the cursor in the 3d view.



Sculpt Mode Dropdown.

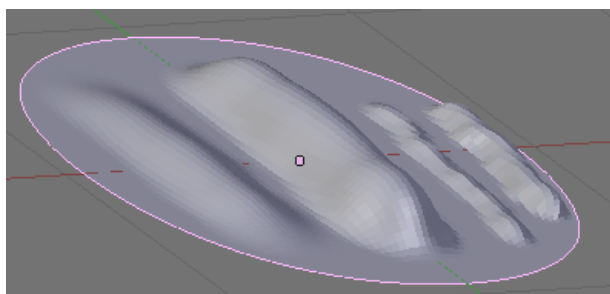


The cursor in Sculpt Mode.

Sculpt Brushes

Brushes are brush presets. They are a combination of a 'tool', along with stroke, texture, and options.

Sculpt Mode has sixteen brushes, each of which operates on the model in a unique way. Many can be toggled to have an additive or subtractive effect. They can be selected in the Tool menu. The current Brush presets are: Blob, Clay, Crease, Draw, Fill/Deepen, Flatten/Contrast, Grab, Inflate/Deflate, Layer, Nudge, Pinch/Magnify, Rotate, Scrape/Peak, Smooth, Snake Hook, Thumb:



Drawing in various sizes and strengths.

Blob

Pushes mesh outward or inward in a spherical shape.

Clay

Similar to the Draw brush, but includes settings to adjust the plane on which the brush acts.

Crease

Creates sharp indents or ridges by pushing or pulling the mesh, while pinching the vertices together.

Draw (D)

Moves vertices inward or outward, based on the average normal of the vertices contained within the drawn brush stroke.

Fill

The Fill brush works like the Flatten brush, but only brings vertices below the brush plane upwards. The inverse of the Scrape brush is to Deepen by pushing vertices below the plane downward.

Flatten (T)

The Flatten brush finds an 'area plane' located by default at the average height above/below the vertices within the brush area. The vertices are then pulled towards this plane. The inverse of the Flatten brush is the Contrast brush which pushes vertices up or down away from the brush plane.

Grab (G)

Grab is used to drag a group of points around. Unlike the other brushes, Grab does not modify different points as the brush is dragged across the model. Instead, Grab selects a group of vertices on mousedown, and pulls them to follow the mouse. The effect is similar to moving a group of vertices in Edit mode with proportional-editing enabled, except that Grab can make use of other Sculpt Mode options (like textures and symmetry.)

Inflate (I)

Similar to Draw, except that vertices in Inflate mode are displaced in the direction of their own normals.

Layer (L)

This brush is similar to Draw, except that the height of the displacement layer is capped. This creates the appearance of a solid layer being drawn. This brush does not draw on top of itself; brush stroke intersects itself. Releasing the mouse button and starting a new stroke will reset the depth and paint on top of the previous stroke.

Nudge

Moves vertices in the direction of brush stroke.

Pinch (P)

Pinch pulls vertices towards the center of the brush. The inverse setting is Magnify, in which vertices are pushed away from the center of the brush.

Rotate

Rotates vertices within the brush in the direction the cursor is moved.

Scrape

The Scrape brush works like the Flatten brush, but only brings vertices above the plane downwards. The inverse of the Scrape brush is to Peak by pushing vertices above the plane up away from the plane.

Smooth (S)

As the name suggests, eliminates irregularities in the area of the mesh within the brush's influence by smoothing the positions of the vertices.

Snake Hook

Pulls vertices along with the movement of the brush to create long, snake-like forms.

Thumb

Similar to the Nudge brush, this one flattens the mesh in the brush area, while moving it in the direction of the brush stroke.

Sculpting with the Multires Modifier

...

Sculpt Properties Panel

This panel appears in the tool palette on the left side of the 3D viewport.

Brush Menu

Radius

This option controls the radius of the brush, measured in pixels. F in the 3D view allows you to change the brush size interactively by dragging the mouse and then left clicking (The texture of the brush should be visible inside the circle). Typing a number then enter while in F sizing allows you to enter the size numerically. Brush size can be affected by enabling the pressure sensitivity icon, if a supported tablet is being used.

Strength

Strength controls how much each application of the brush affects the model. For example, higher values cause the Draw brush to add depth to the model more quickly, and cause the Smooth brush to smooth the model more quickly. This setting is not available for Grab, Snake Hook, or Rotate.

If the range of strengths doesn't seem to fit the model (for example, if even the lowest strength setting still makes too large of a change

on the model) then you can scale the model (in Edit Mode, not Object Mode). Larger sizes will make the brush's effect smaller, and vice versa. You can change the brush strength interactively by pressing \diamond ShiftF in the 3D view and then moving the brush and then left clicking. You can enter the size numerically also while in \diamond ShiftF sizing. Brush strength can be affected by enabling the pressure sensitivity icon, if a supported tablet is being used.

Autosmooth

Sets the amount of smoothing to be applied to each stroke

Sculpt Plane

Use this menu to set the plane in which the sculpting takes place.

Plane Offset

Adjusts the plane on which the brush acts toward or away from the viewer.

Trim

Enables trimming of the sculpt plane, determined by the Distance setting.

Front Faces Only

When enabled, brush only affects vertices that are facing the viewer.

Accumulate

Causes stroke dabs to accumulate on top of each other.

Stroke Menu

Stroke Method

Defines the way brush strokes are applied to the mesh:

Dots

Standard brush stroke.

Drag Dot

Creates a single displacement in the brush shape. Click then drag on mesh to desired location, then release.

Space

Creates brush stroke as a series of dots, whose spacing is determined by the Spacing setting. Spacing represents the percentage of the brush diameter.

Anchored

Creates a single displacement at the brush location. Clicking and dragging will resize the brush diameter. When Edge to Edge the brush location and orientation is determined by a two point circle, where the first click is one point, and dragging places the second point, opposite from the first.

Airbrush

Flow of the brush continues as long as the mouse click is held, determined by the Rate setting. If disabled, the brush only modifies the model when the brush changes its location. This option is not available for the Grab brush.

The following parameters are available for the Dots, Space, and Airbrush strokes:

Smooth stroke

Brush lags behind mouse and follows a smoother path. When enabled, the following become active:

Radius

Sets the minimum distance from the last point before stroke continues.

Factor

Sets the amount of smoothing

Jitter

Jitters the position of the brush while painting.

Curve Menu

The Curve section allows you to use a curve control to the right to modify the intensity of the brush from its centre (left part of the curve) towards its borders (right part of the curve).

Texture Menu

A texture can be used to determine the strength of brush effects as well. Select an existing texture from the texture box, or create a new one by selecting the New button

Brush Mapping

Sets the way the texture is mapped to the brush stroke:

Fixed

If Fixed is enabled, the texture follows the mouse, so it appears that the texture is being dragged across the model.

Tiled

The Tile option tiles the texture across the screen, so moving the brush appears to move separately from the texture. The Tile option is most useful with tileable images, rather than procedural textures.

3D

The 3D option allows the brush to take full advantage of procedural textures. This mode uses vertex coordinates rather than the brush location to determine what area of the texture to use.

Angle

This is the rotation angle of the texture brush. It can be changed interactively via CtrlF in the 3D view. While in the interactive rotation you can enter a value numerically as well. Can be set to:

User

Directly input the angle value.

Rake

Angle follows the direction of the brush stroke. Not available with 3D textures.

Random

Angle is randomized.

Offset

Fine tunes the texture map placement in the x, y, and z axes.

Size

This setting allows you to modify the scaling factor of the texture. Not available for Drag textures.

Sample Bias

Value added to texture samples.

Overlay

When enabled, the texture is shown in the viewport, as determined by the ;Alpha value.

Symmetry Menu

Mirror the brush strokes across the selected local axes. Note that if you want to alter the directions the axes point in, you must rotate the model in Edit Mode, not Object Mode.

Feather

Reduces the strength of the stroke where it overlaps the planes of symmetry.

Radial

These settings allow for radial symmetry in the desired axes. The number determines how many times the stroke will be repeated within 360 degrees around the central axes.

Options Menu

Threaded Sculpt

Takes advantage of multiple CPU processors to improve sculpting performance.

Fast Navigation

For ;Multires models, show low resolution while navigation the viewport.

Show Brush

Shows the brush shape in the viewport.

Unified Settings

;Size

Forces the brush size to be shared across brushes.

;Strength

Forces the brush strength to be shared across brushes.

Lock

These three buttons allow you to block any modification/deformation of your model along selected local axes, while you are sculpting it.

Appearance Menu




You can set the color of the brush depending on if it is in additive or subtractive mode.

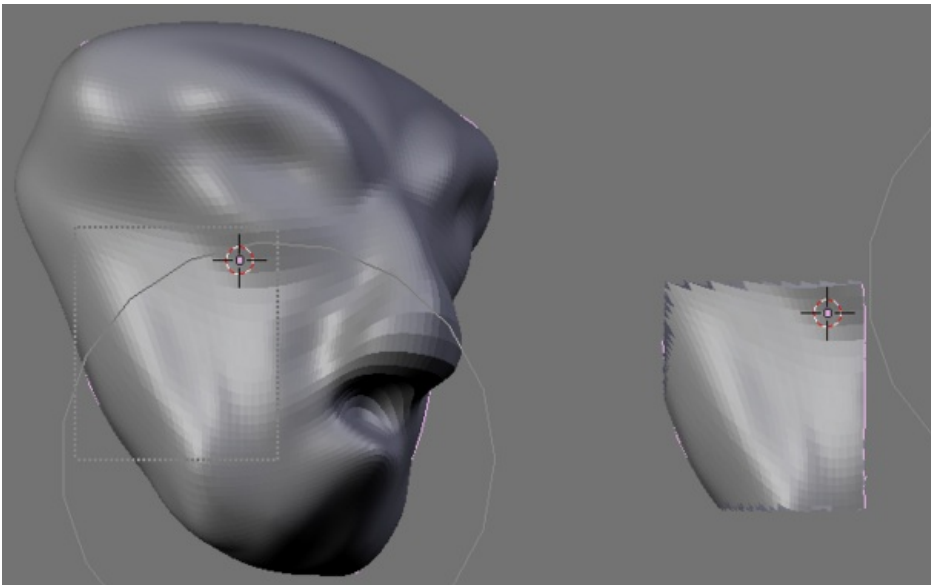
You can also set the brush icon from an image file.

Tool Menu

Here you can select the type of brush preset to use. Reset Brush will return the settings of a brush to its defaults. You can also set Blender to use the current brush for Vertex Paint mode, Weight Paint mode, and Texture Paint mode using the toggle buttons.



Hiding and Revealing Mesh

It is sometimes useful to isolate parts of a mesh to sculpt on. To hide a part of a mesh, Ctrl⇧ LMB -drag around the part you want to keep - everything else will be hidden. Or Ctrl⇧ Shift RMB -drag to hide only the selected rectangle. To reveal all hidden parts, just hit AltH or click and release Ctrl⇧ LMB .



Before and after Hiding.

Keyboard Shortcuts

Action	Shortcut
Hide mesh outside selection	Ctrl⇧ Shift LMB 
Hide mesh inside selection	Ctrl⇧ Shift RMB 
Show entire mesh	AltH
Toggle airbrush	A
Interactively set brush size	F
Interactively set brush strength	⇧ ShiftF
Interactively rotate brush texture	CtrlF
Toggle brush direction (Add/Sub)	V
Draw brush	D
Smooth brush	S
Pinch brush	P
Inflate brush	I
Grab brush	G

Layer brush	L
Flatten brush	T
X Symmetry	X
Y Symmetry	Y
Z Symmetry	Z
Toggle floating sculpt panel	N
Step up one multires level	Page up
Step down one multires level	Page down

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Removed from Blender 2.5

This feature is no more available in Blender 2.5, see the [Multires modifier](#).

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Modeling/Meshes/Editing/Multires>"

Doc:2.6/Manual

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Vertex Groups

A mesh is a set of connected Vertices, sometimes thousands of vertices for the more complex objects. Blender allows you to group these vertices for several main reasons:

- Re-using parts of a mesh for making copies
- Hiding “everything else” while you work on details
- Documentation and explanation to others
- Armatures deformation
- Generating particles from only the group
- Controlling the velocity of particles emitted
- Assigning multiple materials to a single mesh

Armatures

Vertex Groups can be automatically created for each bone in an armature. This rather complex process is, however, discussed elsewhere. This section will focus solely on user-defined vertex groups.

Why use Vertex Groups?

Vertex groups identify sub-components of an object, like the legs of a chair or the hinges of a door. By “bookmarking” such regions in vertex groups you can easily select and work on them in isolation without having to create separate objects. With the hide function you can even remove everything else from view.

Vertex groups also make it easy to cull out and duplicate a part of the mesh many times. Consider modeling a Lego block. The most simple block consists of a base and a nipple. To create a four-nipple block, you would want to be able to easily select the nipple vertices, and, still in Edit mode, duplicate them and position them where you want them.

Another use for vertex groups is for skinning an armature. If you want to animate your mesh and make it move, you will define an armature which consists of a bunch of invisible bones. As a bone moves, it deforms or moves the vertices associated with it. Not all of the vertices, but some of them; the ones assigned to it. So, when you move the bone “Arm”, the arm bone moves the “Arm” vertices, and not the “Leg” vertices. In this way, parts of the mesh can stretch and move around, while other parts remain stationary.

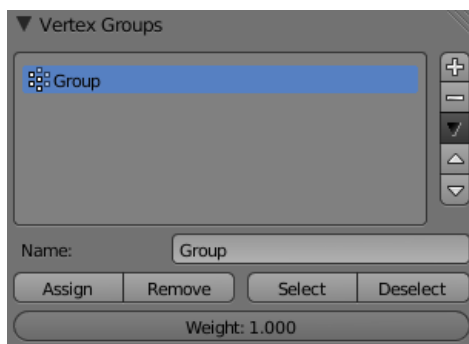
The Particle System menu has a Vertex group panel where various properties can be limited to vertex groups. The vertex group's weight painting can control the amount, size, and velocity of the particles. For example, Hair — a kind of particle system — can use a vertex group named `Scalp` to have the hair emitted from only a part of the skull.

Additionally, many Modifiers use Vertex Groups to limit their influence. Some modifiers, such as the [Mask Modifier](#), need a vertex group to have any effect at all.

Note

Vertex groups are not always required to assign properties to a limited selection of vertices. For example, when multiple materials are added to a mesh each material must be assign to a set of vertices, but assigning those vertices to a vertex group is not necessary.

Creating and Deleting

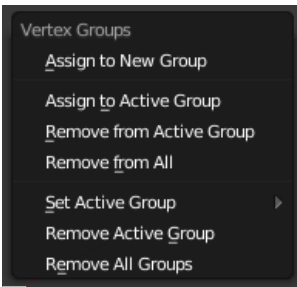


Vertex Groups panel in edit mode


By default, an object does not have any groups, and all of its vertices are hanging out there in cyberspace as loners. While vertex groups can be automatically generated in some contexts, for example when weight painting, we typically create and modify vertex groups in the Vertex group panel in the Object data menu. Once a vertex group has been added, and when we are in Edit Mode, the vertex group panel expands to display a row of buttons.

Vertex groups only apply to meshes

Vertex Groups are only available for objects that have vertices. Text objects, for example, cannot have vertex groups and the panel is not shown when that kind of object is selected. Vertex Groups are only shown when an object with vertices (a mesh) is being edited.




Vertex Groups popup menu

To create a vertex group, LMB  click the + button. When you do, a new vertex group (named, surprisingly, “Group”) is created, and the panel shows you a Weight numeric slider/entry/scroll box. Any selected vertices are not yet assigned to the new vertex group, you must click the Assign button to actually allocate vertices to the newly created vertex group. Note that using the Shortcut CtrlG » Add to New Group, you do all this in one step.

Check Your Assignment


It's a good idea to make sure the vertices have been properly assigned to the group by using the deselect and select buttons. If nothing happens, just hit the Assign button to add the selected vertices to the group.

To delete a vertex group, select it from the list and click the - button. Yes, it's as simple as that. Any vertices that belonged to that group are unassigned from that group. However, please keep in mind that vertices can belong to many groups. When they are unassigned from one group, they still belong to their other groups.

To name a group something other than the creative “Group”, ⇧ Shift LMB  click the name field, and simply type in the name you want. Choosing short, self-explanatory names is crucial in larger projects involving many users.



Selecting and Deselecting

From experience, we have found that it is best to start first by seeing the existing vertices in a group, before adding more or removing some. To do this, first de-select all vertices by pressing A once or twice in the 3D view. Then, with the appropriate group active, press the Select button. In your 3D window, the vertices that belong to the active group will be selected and highlighted.

Sometimes you will want to see if any vertices are still loners. To do so, select All the vertices in the 3D window. For each Vertex Group, LMB  click the Deselect button to de-select the vertices in that group. Repeat the de-selection for each group. When you run out of groups, any vertices left highlighted are the loners. Sort of like picking baseball teams.

Assigning and Removing Vertices

To add vertices to a group you do the following:


1. Select the group you want to work with from the group list.
2. Use your mouse to ⇧ Shift RMB  select more vertices that you want in that group.
3. LMB  click the Assign button, or make CtrlG » Add Selected to Active Group.

Keep in mind that a vertex can be assigned to multiple groups.

Note

The Assign button only adds the currently selected vertices to the active group. Vertices already assigned to the group are not removed from the group.

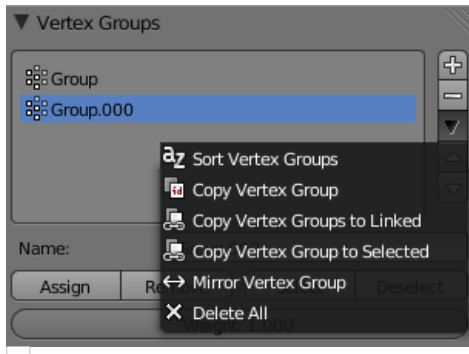
To remove vertices from a group:

1. Select the group you want to work with from the group list.
2. Select the vertices you want to remove from the vertex group.
3. LMB  click the Remove button, or use CtrlG » Remove from Active Group.

Note

You can remove selected vertices from all groups at once, using the Vertex Groups popup menu (CtrlG » Remove from All).

Vertex Group Management



Vertex groups panel's dropdown menu

Sort Vertex Groups

Sort vertex groups alphabetically

Copy Vertex Group

Create a copy of the active vertex group (i.e. vertices assigned to the active group are automatically assigned to the new group.)

Copy Vertex Group to Linked

Copy vertex groups to all linked duplicates

Copy Vertex Group to Selected

Copy vertex groups to other selected meshes

Mirror Vertex Group

Mirror all vertex groups, flip weights and/or names, editing only selected vertices, flipping when both sides are selected otherwise copy from unselected

Delete All

Delete all vertex groups

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Weight Paint Mode

The Weight Paint mode is used to create and modify vertex groups. A vertex may not only be a member of one or more vertex groups, but also may have a certain weight in each group. The weight symbolizes its influence on the result.

Weight painting is primarily used for rigging meshes, but may also be used for controlling particle emission, and hair density.

Mode: Weight Paint mode

Hotkey: Ctrl+ Tab

Menu: Mode menu (*Image 1*)

When you change to Weight Paint mode you see the selected object (if you have not created any groups yet), in a slightly shaded, blue color (*Image 2*).

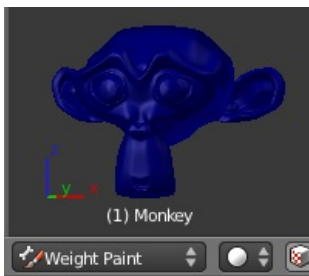


Image 2: An object in Weight Paint mode.

The color visualizes the weight of each vertex of the currently active group. A vertex drawn in blue indicates either: a weight of zero, not in the active group, or not in any group at all.

You can customize the colors in the weight gradient by enabling Custom Weight Paint Range in the System tab of the User Preferences.

You assign the weight of each vertex by painting on the mesh with a certain color. Starting to paint on a mesh will automatically creates a new vertex weight group (when no group existed or is active). If a vertex doesn't belong to the active group it is automatically added (if the option Vgroup is not set), even if you paint with a weight of "0". The used color spectrum is shown in (*Image 3*).

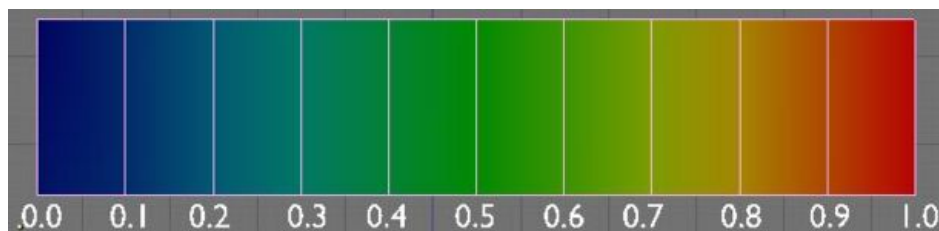


Image 3: The color spectrum and their respective weights.

You paint on the mesh with a brush. The color only influences the vertices, neither the faces nor the edges. So don't try and paint these. There is a tool panel for the brush in the Editing context (F9) as well as in the 3D Window (press N to open it).



Weight Painting survival tips

A few tips that will save you some hassle when painting weight:

- Press F in Weight Paint mode to resize the brush
- Draw a *Clipping Border* with AltB. It will separate a visible part of the 3D window. You can draw only in this part. If you press AltB again the *clipping border* will be removed.

Paint Panel

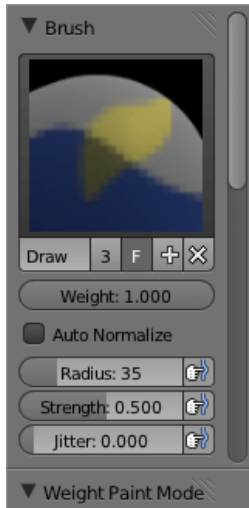


Image 4: The Paint panel in the Editing context.

The tools in the Paint panel are sophisticated, and you can apply weight in the finest nuances. But normally you won't need all these options, and you will apply weight using a few techniques. The most used and important settings are **drawn in bold**.

Weight

The weight (color) that is used to paint. The button row below contains several weight presets to paint. By default, painting works with an absolute fixed amount (like Gimp or Photoshop defaults), so you can set for example "0.2 weight" to vertices while keeping the mouse button pressed, whatever their original weight was.

Auto Normalize

Ensures that all vertex groups add up to 1 while painting.

Radius F

The size of the brush, which is drawn as a circle during painting.

Strength

How powerful the effect of the brush is, when applied.

Jitter

Jitter the position of the brush while painting

Weight Tools

When these tools are activated, additional options are available in the tool settings section at the bottom of the properties panel.

Normalize All

Normalization makes sure that the sum of the weights for each vertex in all of the groups is equal to 1. This tool normalizes all of the vertex groups.

Lock Active

This keeps the values of the active group while normalizing others.

Normalize

This normalizes the just the values of the current vertex group

Invert

Inverts the weight values (1-value)

Add Weights

Add vertices from groups that have zero weights before inverting

Remove Weights

Remove vertices from groups that have zero weights before inverting

Clean

Remove vertex group assignments which are not required

Limit

Remove weights under this limit

All Groups

Clean all vertex groups

Keep Single

Keep vertices to at least one group when cleaning

Levels

Adjust weight values using the following tools:

Offset

Value to add to weights

Gain

Value to multiply weights by

Stroke

Airbrush

The Airbrush option applies the paint effect while holding the mouse.

Smooth Stroke

Causes brush to lag behind mouse and follow a smoother path.

Radius

Minimum distance from last point before stroke continues

Factor

Higher values give a smoother stroke

Space

Limit brush application to distance specified by Spacing value, as a percentage of brush radius.

Curve

Set a custom brush shape by reshaping the curve

The bottom row of button are preset curve shapes.

Options

All faces

If this is turned off, you will only paint vertices which belong to a face on which the cursor is. This is useful if you have a complicated mesh and you would paint on visually near faces that are actually quite distant in the mesh.

Normals

The vertex normal (helps) determine the extent of painting. This causes an effect as if painting with light.

Spray

The Spray option accumulates weights on every mouse move.

X-mirror

Use the X-mirror option for mirrored painting on groups that have symmetrical names, like with extension `.R/ .L`, or `_R/ _L`. If a group has no mirrored counterpart, it will paint symmetrical on the active group itself. You can read more about the naming convention in [Editing Armatures: Naming conventions](#). The convention for armatures/bones apply here as well.

Topology Mirror

Use topology based mirroring, for when both side of a mesh have matching mirrored topology.

Unified Settings: The Size and Strength of the brush can be set to be shared across different brushes, as opposed to per-brush.

Appearance

Here you can set the color of the brush cursor, or load a custom icon from a file.

Tool

The tool defines how the weight values are applied to the vertices.

Mix

The new color replaces the old color. Applying more and more of the new color will eventually turn it the new color.

Add

The new color is added to the old. Note that you must think in weight here (not in RGB colors): adding blue (**0.0**) to something won't modify it, adding green (**0.5**) to green will give red (**1.0**), ...

- Sub
The new color is subtracted from existing. Here again you have to think in terms of “weight”, and not “RGB colors”.
- Mul
The new color is multiplied by the old.
- Blur
Blurs the color with surrounding values.
- Lighten
Only paints vertices “darker” (lower weight) than the current “color”, “lightening” them.
- Darken
Only paints vertices “lighter” (higher weight) than the current “color”, “darkening” them.

- **Vgroup:** Only vertices which belong to the active vertex group are painted. Very useful for clearing up and refining vertex groups without messing other groups up.

Face Selection Masking

If you have a complex mesh it is nearly impossible to reach all vertices in Weight Paint mode. And it is quite difficult to tell where the vertices are exactly. But there’s a very good and easy solution: the Face Selection Masking mode. The Face Selection masking button on the header panel allows you to select faces and limit the weight paint tool to those faces.

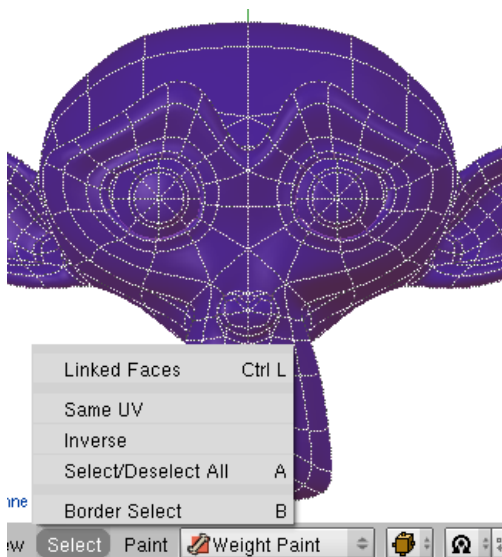


Image 5: Select menu in Weight Paint mode.

Select mode has many advantages over the normal Weight Paint mode:

1. The original mesh is drawn, even when subsurface is active. You can see the vertices you have to paint over.
2. You can select faces, only the vertices of selected faces are painted on.
3. Selecting tools include:
 - RMB – Single faces. Use Shift RMB to select multiple.
 - A – All faces, also to de-select.
 - B – Block/Box selection.
 - BB – Select with brush.
 - CtrlL – Select linked.
 - In the Select menu: Faces with Same UV, also invert selection (Inverse).
4. You may hide selected faces with H and show them again with AltH (**Image 6**).

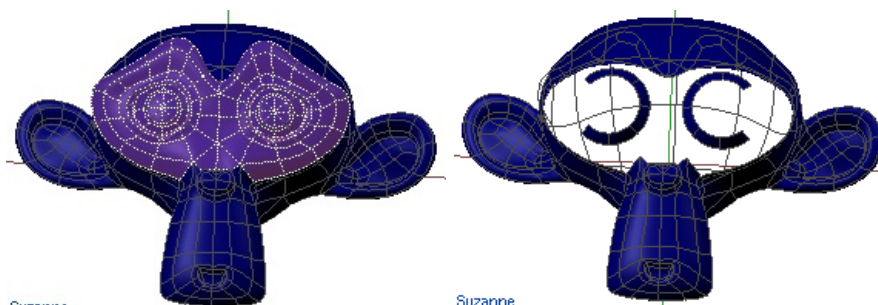



Image 6a: Select interfering faces...

Image 6b: ... and hide them with H.


- To constraint the paint area further you may use the *Clipping Border*. Press AltB and LMB -drag a rectangular area. The rest of the 3D window is hidden. To show everything again, just hit another time AltB.


Weight Painting for Bones

This is probably the most often used application of weight painting. When a bone moves, vertices around the joint should move as well, but just a little, to mimic the stretching of the skin around the joint. Use a “light” weight (10-40%) paint on the vertices around the joint so that they move a little when the bone rotates. While there are ways to automatically assign weights to an armature (see the [Armature section](#)), you can do this manually. To do this from scratch, refer to the process below. To modify automatically assigned weights, jump into the middle of the process where noted:

- Create an armature.
- Create a mesh that will be deformed when the armature’s bone(s) move.
- With the mesh selected, create an Armature modifier for your mesh (located in the Editing context, Modifiers panel). Enter the name of the armature.

Pick up here for modifying automatically assigned weights.

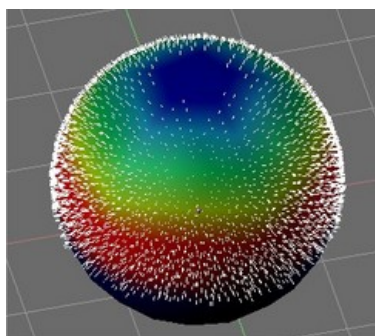
- Select the armature in 3D View, and bring the armature to **Pose mode** (Ctrl⇧ Tab, or the 3D View window header mode selector).
- Select a desired bone in the armature.
- Select your mesh (using RMB ) and change immediately to Weight Paint mode. The mesh will be colored according to the weight (degree) that the selected bone movement affects the mesh. Initially, it will be all blue (no effect).
- Weight paint to your heart’s content. The mesh around the bone itself should be red (generally) and fade out through the rainbow to blue for vertices farther away from the bone.

You may select a different bone with RMB . If the mesh skins the bones, you will not be able to see the bones because the mesh is painted. If so, turn on X-Ray view (Buttons window, Editing context, Armature panel). While there on that panel, you can also change how the bones are displayed (Octahedron, Stick, B-Bone, or Envelope) and enable Draw Names to ensure the name of the selected bone matches up to the vertex group.

If you paint on the mesh, a vertex group is created for the bone. If you paint on vertices outside the group, the painted vertices are automatically added to the vertex group.

If you have a symmetrical mesh and a symmetrical armature you can use the option X-Mirror. Then the mirrored groups with the mirrored weights are automatically created.

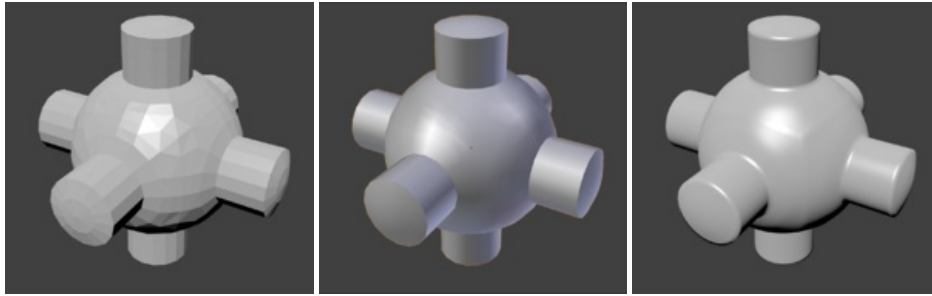
Weight Painting for Particles



Weight painted particle emission.

Faces or vertices with zero weight generate no particles. A weight of 0.1 will result in 10% of the amounts of particles. This option “conserves” the total indicated number of particles, adjusting the distributions so that the proper weights are achieved while using the actual number of particles called for. Use this to make portions of your mesh hairier than others by weight painting a vertex group, and then calling out the name of the vertex group in the VGroup: field (Particles panel, Object context).

Mesh smoothing



Example mesh rendered flat, smoothed using edge split, and using Subdivision Surface. Note how edges are rendered differently. [Sample .blend](#)

As seen in the previous sections, polygons are central to Blender. Most objects are represented by polygons and truly curved objects are often approximated by polygon meshes. When rendering images, you may notice that these polygons appear as a series of small, flat faces.

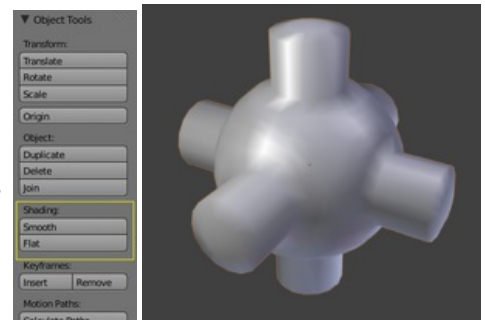
Sometimes this is a desirable effect, but usually we want our objects to look nice and smooth. This section shows you how to visually smooth an object, and how to apply the Auto Smooth filter to quickly and easily combine smooth and faceted polygons in the same object.

The last section on this page shows the possibilities to smooth a mesh's geometry, not only its appearance.

Smooth shading

The easiest way is to set an entire object as smooth or faceted by selecting a mesh object, and in Object mode click Smooth in the Tool Shelf. This button does not stay pressed, it forces the assignment of the "smoothing" attribute to each face in the mesh, also when you add or delete geometry.

Notice that the outline of the object is still strongly faceted. Activating the smoothing features doesn't actually modify the object's geometry; it changes the way the shading is calculated across the surfaces, giving the illusion of a smooth surface. Click the Flat button in the Tool Shelf's Shading panel to revert the shading back to that shown in the first image above.



Same mesh smooth shaded

Smoothing parts of a mesh

Alternatively, you can choose which edges to smooth by entering Edit mode, then selecting some faces and clicking the Smooth button. The selected edges are marked in yellow.

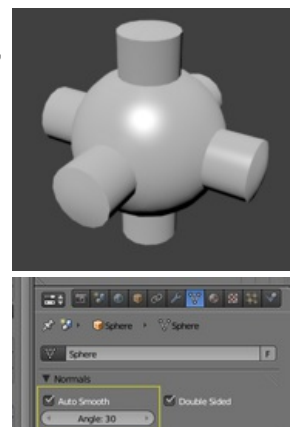
When the mesh is in Edit mode, only the selected edges will receive the "smoothing" attribute. You can set edges as flat (removing the "smoothing" attribute) in the same way by selecting edges and clicking the Flat button.

Auto Smooth

It can be difficult to create certain combinations of smooth and solid faces using the above techniques alone. Though there are workarounds (such as splitting off sets of faces by selecting them and pressing Y), there is an easier way to combine smooth and solid faces, by using Auto Smooth.

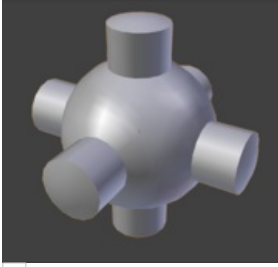
Auto smoothing can be enabled in the mesh's panel in the Properties window. Angles on the model that are smaller than the angle specified in the Angle button will be smoothed during rendering (i.e. not in the 3D view) when that part of the mesh is set to smooth. Higher values will produce smoother faces, while the lowest setting will look identical to a mesh that has been set completely solid.

Note that a mesh, or any faces that have been set as Flat, will not change their shading when Auto Smooth is activated: this allows you extra control over which faces will be smoothed and which ones won't by overriding the decisions made by the Auto Smooth algorithm.



Example mesh with Auto

Edge Split Modifier



Edge Split modifier enabled

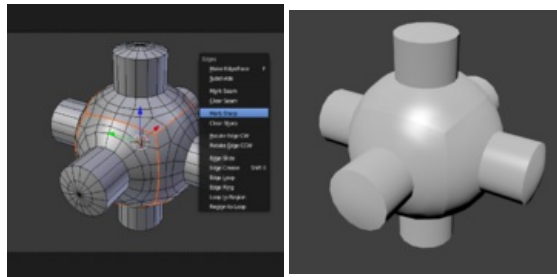
With the [Edge Split](#) modifier we get a result similar to Auto Smooth with the possibility to choose which edges should be split.

Edge Angle

Use angles across edges to determine which edges to split. Similar to Auto Smooth. Angle can be set between 0° and 180°.

Sharp Angles

Use edges marked as sharp to determine which angles to split. In Edit mode, we can select a set of edge loops using, for example, Alt+Shift+RMB and then marking the as sharp in the Edge menu (Ctrl+E>Mark Sharp.)



With a selection of edge loops set as Mark sharp, we can control how the mesh is rendered.

Smoothing the mesh geometry

The above techniques do not alter the mesh itself, only the way it is displayed and rendered. Instead of just making the mesh look like a smooth surface, you can also physically smooth the geometry of the mesh with these tools:

Mesh editing tools

You can apply one of the following in Edit mode:

- [Smooth](#)

This relaxes selected components, resulting in a smoother mesh

- [Subdivide Smooth](#)

Adjusting the smooth parameter after using the subdivide tool results in a more organic shape. This is similar to using the subdivide modifier.

- [Bevel](#)

This Bevels selected edges, causing sharp edges to be flattened

Modifiers

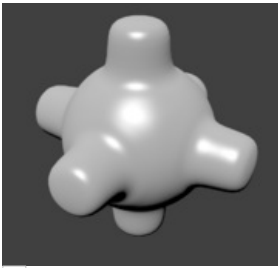
Alternatively, you can smooth the mesh non-destructively with one or several of the following modifiers:

[Smooth Modifier](#)

Works like the Smooth tool in Edit mode; can be applied to specific parts of the mesh using vertex groups.

[Bevel Modifier](#)

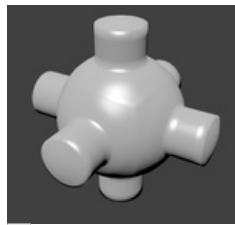
Works like the Bevel tool in Edit mode; Bevel can be set to work on an angle threshold, or edge weight values.



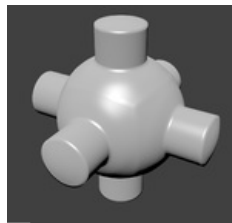
☐ Subsurf

[Subdivision Surface Modifier](#)

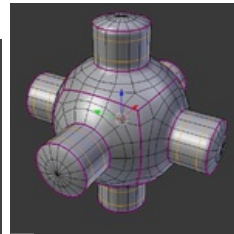
Catmull-Clark subdivision produces smooth results. Sharp edges can be defined with [subdivision creases](#) or by setting certain edges to “sharp” and adding an [EdgeSplit modifier](#) (set to From Marked As Sharp) before the Subsurf modifier.



☐ Using creased edges, and resulting subsurf artifacts



☐ Extra edge loops added



☐ 3D view showing creased edges (pink) and added edges loops (yellow)

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Proposed fixes: none

Curves

Curves and [Surfaces](#) are objects just as meshes are objects except they are expressed in terms of mathematical functions, rather than as a series of points.

Blender implements both [Bézier](#) curves and Non-Uniform Rational B-Splines ([NURBS](#)) curves and surfaces. Both are defined in terms of a set of “control vertices” (or “control points”) which define a “control polygon”, though each follow a different set of mathematical laws. The way the curve and the surface are interpolated might seem similar, at first glance, to Catmull-Clark subdivision surfaces. The curve is *interpolated* while the surface is *attracted*.

Compared to Polygonal Mesh

One main advantage to curves over polygonal meshes is that curves are defined by less data, so can produce excellent results using less memory and storage space at modeling time. However, this procedural approach to surfaces can increase demands at render time.

Some modeling techniques like [extruding](#) a profile along a path are only possible using curves. At the same time, vertex-level control is more difficult when using curves.

There are times when curves and surfaces are more advantageous than meshes, and times when meshes are more useful. It is recommended you read the section on [mesh editing](#), which should help you decide whether to use meshes or curves in your project.

When you have finished reading and learning about Bézier and NURBS curves there are several more advanced examples on the application of curves in the [tutorials](#) section for modeling complex objects.



☐ Logo Thumbnail.

There is a [Working example](#) that shows how to create an interesting bird-like logo. The tutorial covers most aspects of working with Bézier curves including: adding curves, setting up a background image as a template guide and beveling the final curve.

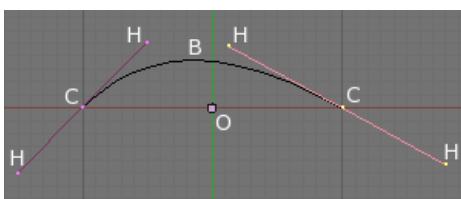
In addition, the Tutorial section has examples on both [Skinning](#) and [Curve deform](#) techniques.

Finding Curve Tools

Most of the curve tools are regrouped in three panels: [Curve and Surface](#), [Curve Tools](#) and [Curve Tools1](#).

You will also find many options in the Select and Curve menus of the 3D view header, as well as in the Specials menu (W).

Visualization



Bézier curve example.



NURBS curve example.

In Edit mode, the curve is drawn as a black line, and in Solid shading (or Shaded, ...), the closed curves are filled with a flat surface. 3D curves have additional “arrows” all along the curve, illustrating both the direction and the *relative* speed of the movement objects will have when following them as path (unless a custom Speed lpo is defined...).

Each control point is drawn in purple. Bézier “vectors” are materialized with pink lines, whereas NURBS vertices are linked by yellow lines. As with meshes, selected vertices are highlighted in yellow (with a lighter shade for the active element).

Hiding Elements

As in Object mode, you can hide what is selected, and then reveal what was hidden. This is very handy to clean up a bit your views, when you are working on a complex model with thousands of vertices...

To hide, use CtrlAltH, the Hide button of the Curve Tools1 panel, or use the Curve » Show/Hide Control Points » Hide Selected menu option.

To reveal what was hidden, use AltH, the Reveal button of the Curve Tools1 panel, or the relevant option in the same Curve » Show/Hide Control Points menu.

Curve Structure

About U and V coordinates

U and V are the conventional names of parametric “coordinates” components (note that these are the same names as texture ones...). They are used to define the resolution, the “knots” for NURBS, etc., along given “axis”. For curves, only the U component is relevant (as they have only one dimension, they are lines). The V component is used by NURBS surfaces.

Control Points and Segments

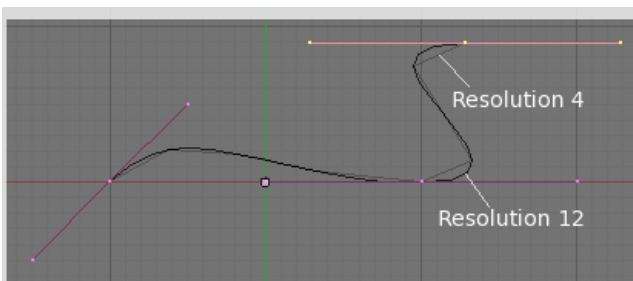
Curves are mainly defined by their control points, as described below in their respective section. However, you will sometimes encounter another concept, the “segment” of curve. A segment is defined implicitly by its two adjacent control-points. Unlike with meshes, you can’t explicitly select a segment – you must select its two adjacent control-points.

Curve Resolution

Although these curves are continuous mathematical objects, they must nevertheless be represented in discrete form (set of small segments) from a rendering point of view. This is done by setting a *resolution* property, which defines the number of points which are computed between every pair of control points. Note that this applies only to Bézier curves, and is different for NURBS.

You have in fact three resolution settings, two in the Curve and Surface panel, and one in the Curve Tools panel:

- DefResolU: The resolution applied by default to all curves of the object, both in the 3D views and at render time.
- RenResolU: The resolution applied by default to all curves of the object when rendering, if not set to zero (else DefResolU is used).
- Resol U: This setting is only available in Edit mode, it will modify the resolution of the curves (partly) selected currently. Note that it is reset to the DefResolU value each time you modify this setting.



Bézier resolution example.

A separate *resolution* can be set for each curve by adjusting the DefResolU field of the [Curve and Surface panel](#). The default is **6**. (*Bézier resolution example*) is an example of the same curve, superimposed with the aid of Gimp, showing two different resolution settings. The lighter shaded curve has a low resolution of **4**; the curve begins to look linear. The darker curve has a resolution of **12** and is very smooth. Note that high resolutions may look nicer but they can slow down interactive rendering if there is a large number of curves (and/or if these ones have a large amount of control points).

2D and 3D Curves

By default, (except for the Path primitive), new curves are 2-dimensional, meaning all control points lie in the same plane (X-Y in Local space). This allows automatic filling of closed curves.

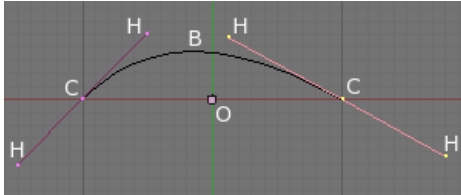
However, you might want to be able to place your control points freely in 3D space. To do so, enable the 3D button of the Object Data panel. Note that you will lose the closed curves filling, and arrows will be displayed as per the [Visualization](#) section above.

Closed and Open Curves

Curves (Bézier or NURBS) are mono-dimensional: they are lines, that never crosses themselves (i.e. control points are only linked to at most two others, forming a continuous line, without any fork...). However, curves can be open (i.e. they start and end points are not linked by a curve segment) or closed. Closed curves are solid, inasmuch that Blender adds a solid flat face inside them (unless they are made 3D).

Béziars

Bézier curves are the most commonly used curves for designing letters or logos. They are also widely used in animation, both as paths for objects to move along and as IPO curves to change the properties of objects as a function of time.



Curve example.

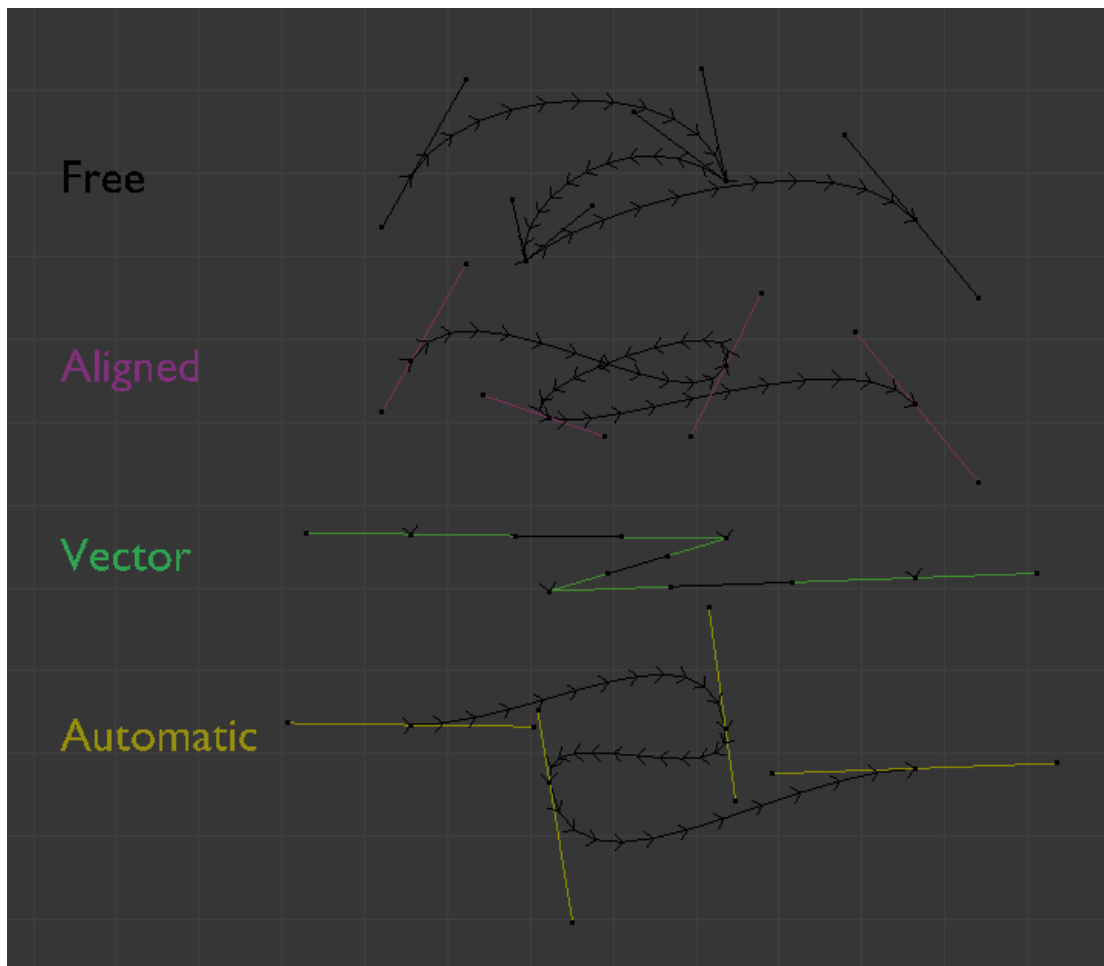
(*Curve example*) is the most basic Bézier curve you can create. It consists of two control points or vertices, labeled “C”, the curve “B”, handles “H” and an object center “O”.

A handle “H” defines the tangent vector to the curve in point “C” (on its side). The “steepness” of the curve is controlled by the handle’s length (“H” to a “C”). The longer a handle is the steeper the curve (i.e. the more curve wants to *hug* the handle).

There are four types of handles (*Types of Handles for Bézier curves*):

- Free Handle (black). The handles are independent of each other. To convert to Free handles use V,F
- Aligned Handle (purple). These handles always lie in a straight line, and give a continuous curve (without sharp angles...). Hotkey: V,L.
- Vector Handle (green). Both parts of a handle always point to the previous handle or the next handle (this allows you to create curves made of straight lines!). Hotkey: V,V.
- Automatic Handle (yellow). This handle has a completely automatic length and direction, set by Blender to ensure the smoothest result. Hotkey: V,A.

You can also use V,T to toggle between Free and Aligned.



Types of Handles for Bézier curves.

Handles can be *grabbed*, *rotated* and *scaled* exactly as ordinary vertices in a mesh would. As soon as the *handles* are moved, the handle type is modified automatically:

- Auto Handles becomes Aligned;
- Vector Handles becomes Free.

NURBS

NURBS curves are defined as rational polynomials and are more general, strictly speaking, than conventional B-Splines and [Bézier](#) curves inasmuch as they are able to exactly follow any contour. For example a Bézier circle is a polynomial *approximation* of a circle, and this approximation is noticeable, whereas a NURBS circle is *exactly* a circle. However, a NURBS cannot have real sharp angles in it, unlike a Bézier curve...

NURBS curves require a little bit more understanding of the underlying components that make up a NURBS curve in order to get full use of them. They have a large set of variables, which allow you to create mathematically pure forms. However, working with them requires a little more discussion on the various parts of a NURBS curve.

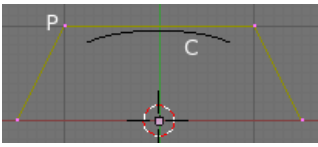
Note

NURBS are a *very* complicated topic, I think they might be a good subject for a “Theory” article – written by someone knowing them deeply! (For a start, here's the [Wikipedia page](#).)

Knots

We start with *Knots*. NURBS curves have a *knot* vector, a row of numbers that specifies the parametric definition of the curve (i.e. they describe the range of influence for each of the control-points). Remember the control-points from Bézier curves, NURBS have them too and each control-point affects some part of the curve along that range. The control-points appear as purple vertices.

Note that *knots* setting concerns only *open* NURBS, not closed ones.

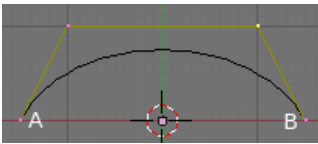


Default Uniform curve.

(*Default Uniform curve*) is the default NURBS curve created using the NURBS Curve menu item from the toolbox's [Add menu](#) and is an example of a Uniform curve. The curve itself is drawn in black, labeled "C" and the control-points are drawn in purple; one out of the 4 is labeled "P".

You can't manipulate the *Knot* vector directly but you can configure it using three presets: Uniform, Endpoint and Bezier.

The Uniform button of the [Curve Tools panel](#) produces a uniform division for closed curves, but when used with open curves you will get "free" ends, which are difficult to locate precisely.

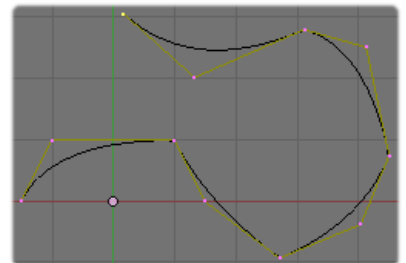


Endpoint curve.

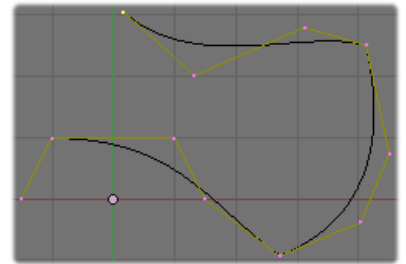
The Endpoint button sets the *Knot* vector in such a way that the first and last vertices are always part of the curve, which makes them much easier to place. (*Endpoint curve*) is an example of applying the Endpoint button to the (*Default Uniform curve*). You can see that the curve has now been pulled to the *end* control-points labeled "A" and "B".

Finally, Bezier "*Knot vector*" (I'm not really sure this remains a real knot, in fact...) make the NURBS control points mimic the Bézier control points behavior. This works only with two orders value (see below): **3** and **4**.

- With an Order of **3**, all odd points act as a center of a Bézier control point, and all even points act as a Bézier handle. So vertices (1,2,3) define a first Bézier segment, (3,4,5) a second one, and so on...
- With an Order of **4**, all four groups of control points define a Bézier segment, i.e. vertices (2,3,4,5) define a first segment, (5,6,7,8) a second one, etc. Note that here, the first vertex is for some reasons unused...



Bezier NURBS, Order 3.

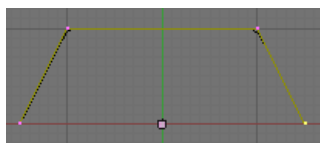


Bezier NURBS, Order 4.

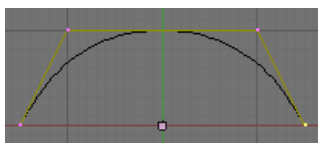
Order

The Order field of the [Curve Tools panel](#) is the "depth" or *degree* of the curve (i.e. you are specifying how much the control-points are taken into account for calculating the curve shape).

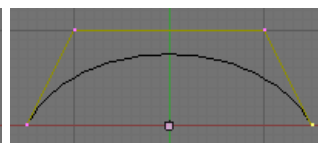
Order **1** is a point and is not an available depth setting, Order **2** is linear (*Order 2 curve*), Order **3** is quadratic (*Order 3 curve*), (*Order 4 curve*) is cubic, and so on. The valid range is **2** to **6**. Notice that as the Order rises the curve moves away from the control-points.



Order 2 curve.



Order 3 curve.



Order 4 curve.

If your curve has **6** or more control-points the Order can not be set higher than **6**. **6** is the highest Order allowable. If you have less than **6** control-points then the highest Order is limited by the number of control-points. For example, if your curve has **5** control-points then the highest Order allowable is **5**.

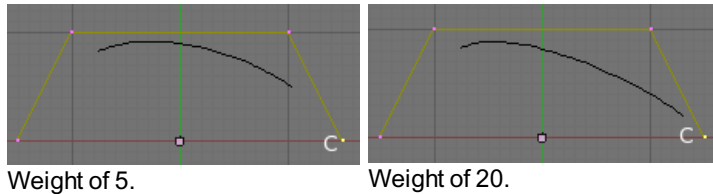
Always use an order of **5**, if possible, for curve paths because it behaves fluidly under all circumstances, without producing irritating discontinuities in the movement. For example, if you have a cube assigned to travel along a NURBS path with an Order of say **2** then the cube will appear to move roughly (or jerky) along the path.

Math Note

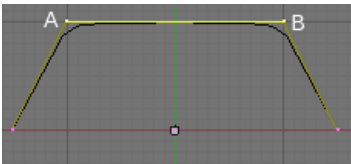
Mathematically speaking the Order is the order of both the Numerator and the Denominator of the rational polynomial defining the NURBS curve.

Weight

NURBS curves have a Weight ([Curve Tools panel](#)) assigned to each control-point that controls how much each “pulls” on the curve. Think of it as if each control-point has an arm that reaches out and grabs hold of the curve and tries to pull on it. The larger the Weight the more the control-point pulls on the curve, see (*Weight of 5*) and (*Weight of 20*). The valid range of Weight settings are **0.1** to **100.0**.



The larger Weight of 20 pulls the curve towards the control-point labeled “C”. Each control-point can have a different Weight setting. As the Weight for a control-point increases the curve will hug the control-points closer. If the Weights are large enough the curve will almost follow the control-points, see (*Weight of 100*).



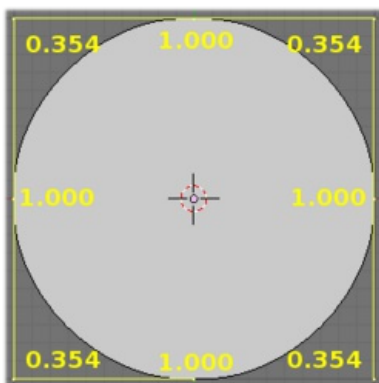
Weight of 100.

The control-points can effectively compete with each other. For example, the control-point with the largest Weight will pull the curve towards it and away from the others. If all the control-points have the same Weight then the Weight is effectively canceled, as if none had Weights.

In (*Weight of 100*) the top two control-points have their Weight set at **100.0**, labeled “A” and “B”. The opposite control-points have their Weight at **1.0**. You can see that the curve is “pulled” toward control-points “A” and “B”. And at such a high Weight the curve almost follows the control-points.

To see the Weight value of a control-point, select it, open the [Transform Properties panel](#) using N, and look at the Vertex W field. The Weight field doesn’t show the Weight!

Preset Weights



A circle NURBS curve.

NURBS curves can create pure shapes such as circles (note that a Bézier circle is not a pure circle). To create pure circles, you must set to specific values the weights of the control-points – some of which are provided as presets in the Curve Tools panel (lower right corner). This is not intuitive, and you should read more on NURBS before trying this.

Basically, to produce a circular arc from a curve with three control-points, the end points must have a unitary weight, while the weight of the central control point must be equal to one-half the cosine of half the angle between the segments joining the points. Lets take an example: if you have three control-points creating a right angle, to get a quadrant, you would set the center point’s weight to $\cos(90/2)/2 = \cos(45)/2 = \text{sqrt}(2)/4 = 2^{-1.5} = 0.354$ (these settings are valid with an order of **4**... so you must have at least four control points, as with three points – and hence an order of **3** –, you won’t get a “circular” quadrant!).

The other presets are more useful for [NURBS surfaces](#) (to create spheres, cylinders, ...).

Primitives

Blender can add five different curve primitives, two Bézier and three NURBS:

- Bezier Curve adds an open 2D Bézier curve with two control points.
- Bezier Circle adds a closed, circle-shaped 2D Bézier curve (made of four control points).
- NURBS Curve adds an open 2D NURBS curve, with four control points, with Uniform knots.
- NURBS Circle adds a closed, circle-shaped 2D NURBS curve (made of eight control points).
- Path adds a NURBS open 3D curve made of five aligned control points, and with Endpoint knots and the CurvePath setting enabled.

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Void page

Proposed fixes: none

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Text from 2.4 with some addition

Proposed fixes: none

Curve Editing

Curve editing has less tools and options compared to its mesh counterpart. This does not mean it is easier or less powerful!

This page covers the basics of curve editing – more advanced topics, like extrusion (and bevel and taper), are addressed in the next sections: [Curve Deform](#) and [Extruding](#).

Basic Curve Editing (translation, rotation, scale)

Mode: Edit mode

Hotkey: G/R/S

Menu: Curve » Transform » Grab/Move, Rotate, Scale, ...

Once you have a selection of one or more control points, you can grab/move (G), rotate (R) or scale (S) them, like many other things in Blender, as described in the [Manipulation in 3D Space](#) section.

Note that Bézier control points contain three vertices (the central one and the two handles), so a whole selected control point is equivalent to three selected vertices for transform tools (i.e. you can rotate and scale it, unlike standard mesh or NURBS vertices).

Note that in general, Bézier curves are easier to edit than NURBS, as when you modify a control point, you only affect the two curve segments on both side of the point. With NURBS, when you move a vertex, the curve can be modified up to three point on both side, depending on the order of the curve... Moreover, a Bézier curve always pass through the center of all its control points – NURBS are far from being so simple!

You also have in Edit mode an extra option when using these basic manipulations: the [proportional editing](#).

Advanced Transform Tools

Mode: Edit mode

Menu: Curve » Transform

The To Sphere, Shear, Wrap and Push/Pull transform tools are described in the [Manipulation in 3D](#) chapter.

The two other tools, Tilt and Shrink/Fatten Radius are related to [curve extrusion](#).

Bézier Control Points Settings

Mode: Edit mode

Panel: Transform Properties (N)

Hotkey: ⇧ ShiftH, H, V

Menu: Curve » Control Points » Automatic, Toggle Free/Aligned, Vector

This only concerns Bézier curves. As we saw in a [previous page](#), these curves can have four types of handles (giving smooth or angled curve...). ⇧ ShiftH makes all selected control points automatic, H toggles between free and aligned, and V makes them vector. Follow above link for more details.

NURBS Control Points Settings

Mode: Edit mode

Panel: Curve Tools (Editing context, F9), and Transform Properties

We also saw in the same [previous page](#) that NURBS control points have a weight, which is the influence of this point on the curve. You set it either using the big Set Weight button in the Curve Tools panel (after having defined the weight in the numeric field to the right),


or by directly typing a value in the W numeric field of the Transform Properties panel.



Adding New Segments

Mode: Edit mode

Hotkey: Ctrl LMB  or E

Menu: Curve » Extrude

Once a curve is created you can add new segments (in fact, new control points defining new segments...), either by extruding it, or placing new handles with Ctrl LMB  clicks. Each new segment is added to one end of the curve. A new segment will only be added if a single vertex, or handle, at one end of the curve is selected. If two or more control points are selected nothing is added (however, if you used the Extrude command, all selected control points are placed in Grab mode...).

Note that unlike with meshes, you can't create a new curve inside the edited object by just Ctrl LMB -clicking with nothing selected – to do so, you can cut an existing curve in two parts (by [deleting a segment](#)), [copy](#) an existing one ( ShiftD), or add a new one (Add menu)...

Opening and Closing a Curve

Mode: Edit mode

Hotkey: AltC

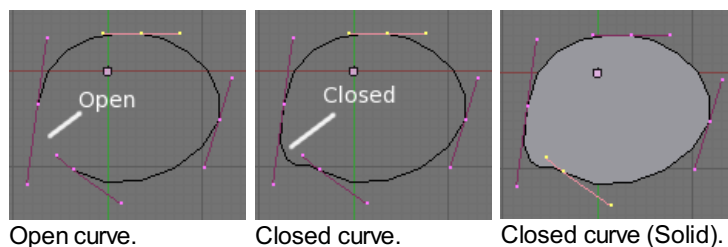
Menu: Curve » Toggle Cyclic

This toggles between an open curve and closed curve. Only curves with at least one selected control point will be closed/open.

The shape of the closing segment is based on the start and end handles for Bézier curves, and as usual on adjacent control points for NURBS. The only time a handle is adjusted after closing is if the handle is an Auto one. (*Open curve*) and (*Closed curve*) is the same Bézier curve open and closed.

This action only works on the original starting control-point or the last control-point added. Deleting a segment(s) doesn't change how the action applies; it still operates only on the starting and last control-points. This means that AltC may actually join two curves instead of closing a single curve!

Remember that when a curve is closed, it creates a renderable flat face.



Duplication

Mode: Edit mode

Hotkey:  ShiftD

Menu: Curve » Duplicate

Well, this command just duplicates the selected control points, along with the curve segments implicitly selected (if any). The copy is selected and placed in Grab mode, so you can move it to another place.

Deleting Elements

Mode: Edit mode

Hotkey: X or Del

Menu: Curve » Delete...

The Erase pop-up menu of curves offers you three options:

Selected

This will delete the selected control points, *without* breaking the curve (i.e. the adjacent points will be directly linked, joined, once the intermediary ones are deleted). Remember that NURBS order cannot be higher than its number of control points, so it might decrease when you delete some control points... Of course, when only one point remains, there is no more visible curve, and when all points are deleted, the curve itself is deleted.

Segment

This option is somewhat the opposite to the preceding one, as it will cut the curve, without removing any control point, by erasing one selected segment.

This option always removes *only one segment* (the last “selected” one), even when several are in the selection. So to delete all segments in your selection, you’ll have to repetitively use the same erase option...

All

As with meshes, this deletes everything in the object!

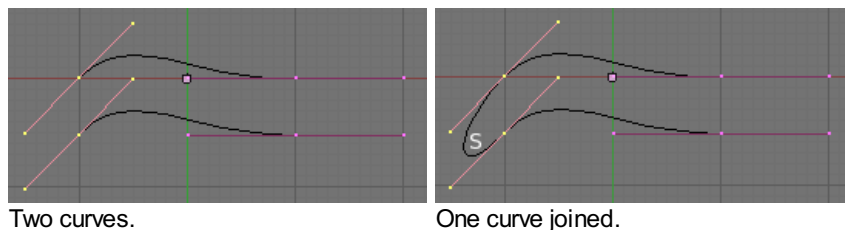
Joining or Merging Curves

Mode: Edit mode

Hotkey: F

Menu: Curve » Make Segment

Joining curves is really the act of making a segment between the two curves. To join two separated use one end control point from each curve. The two curves are joined by a segment to become a single curve. (*One curve joined*) is the result of joining (*Two curves*). The segment, labeled “s”, is the new segment joining the two curves. F for creating curve segments... Well, in fact, the same shortcut creates edges (and faces) in meshes, so...



You cannot close a curve by joining the curves, you must [close](#) the curve. You will get the error “Can't make segment” when you attempt to join using the starting and last control-point. For example, in (*One curve joined*) you must use [close](#) to close the curve. You will get the same error if you have not-end points selected, or too much end-points, etc.

Note that you can only join curves of the same type (i.e. Bézier with Bézier, NURBS with NURBS, ...)!

Subdivision

Mode: Edit mode

Panel: Curve Tools1 (Editing context, F9)

Hotkey: W » 1 NumPad

Menu: Curve » Segments » Subdivide, Specials » Subdivide

Curve subdivision is most simple: using either the Subdivide entry in the Specials menu (W), or the Subdivide button of the Curve Tools1 panel, you will subdivide once all selected segments by adding a new control point exactly between each pair of selected ones.

Switch Direction

Mode: Edit mode

Hotkey: W » 2 NumPad

Menu: Curve » Segments » Switch Direction, Specials » Switch Direction

This command will “reverse” the direction of any curve with at least one selected element (i.e. start point will begin end one, and *vice-versa*). Mainly useful when using curve as path, or the bevel and taper options...

Other Specials Options

Mode: Edit mode

Hotkey: W

Menu: Specials

The Specials menu contains some additional options:

Set Goal Weight

This sets the “goal weight” of selected control points, also found as the Weight property in the Transform Properties panel. I don’t know the use of this setting, though...

Set Radius

This is a setting used by the [Extrusion tool](#)...

Smooth

This command has exactly the same effect as with [meshes](#), it slightly moves the selected points to smooth the overall curve.

Smooth Radius

Well, it just smooths out the Radius value of the control points along the curve...

Conversion

Well, here we will talk about “internal” conversions, between Bézier and NURBS.

There is also an “external” conversion, from curve to mesh, that only works in Object mode. It transforms a Curve object in a Mesh one, using the curve resolution to create edges and vertices. Note also it keeps the faces and volumes created by closed and extruded curves...

Back to our “internal” conversion. The two Bezier and Nurb buttons of the Convert group, in the Curve Tools panel, allow you to convert all (partly) selected curves to the chosen type. Note this is not a “smart” conversion, i.e. Blender do not tries to keep the same shape, nor the same number of control points... For example, when converting a NURBS to a Bézier, each group of three NURBS control points become a unique Bézier one (center point and two handles).

Misc Editing

You have some of the same options as with meshes, or in Object mode. You can [separate](#) a given curve (P), make other selected objects [children](#) of one or three control points (CtrlP – note however that parenting to three control points has a strange behavior with curves...), or [add hooks](#) to control some points with other objects.

The Mirror tool is also available, behaving exactly as with [mesh vertices](#), as well as the [snap](#) commands.

Retopology

Mode: Edit mode

Panel: Curve Tools1 (Editing context, F9)



[Mesh snapping](#) also works with curve components.

It works exactly the same, translating the edited control points perpendicularly to the current 3D view until they hit the surface, edge or vertex, as specified of another object (you must be in Solid or Shaded draw mode for snapping to work).

Recall also that 2D curves have their control points locked on the same XY local plane, so snapping won’t be able to move them along the local Z axis...

Curve Selection

Curve selection in Edit mode is quite less complex than with meshes! Mainly because you have only one selectable element type, the control points (no select mode here...). These points are a bit more complex than simple vertices, however, especially for Béziers, as there is the central vertex, and its two handles...

The basic tools are the same as with [meshes](#), so you can select a simple control point with a LMB -click, add to current selection with ⇧ Shift LMB -clicks, Border-select, and so on.

One word about the Bézier control points: when you select the main central vertex, the two handles are automatically selected too, so you can grab it as a whole, without creating an angle in the curve. However, when you select a handle, only this vertex is selected, allowing you to modify this control vector...

L (or CtrlL) will add to the selection the mouse cursor's nearest control point, and all the linked ones, i.e. all points belonging to the same curve. Note that for Bézier, using L with a handle selected will select the whole control point and all the linked ones.

Select Menu

With curves, all “advanced” selection options are regrouped in the Select menu of the 3D views header. Let's detail them.

Random...
Inverse
Select/Deselect All
Border Select

All these options have the same meaning and behavior as in [Object mode](#) (and the specificities of Border Select in Edit mode have already been discussed [here](#)).

Every Nth

Mode: Edit mode

Hotkey: None

Menu: Select » Every Nth

This only works if you already have at least one control point selected. Using current selection, it will add to it a control point every nth ones, before and after the initial selection. The “selection step” is specified in the N pop-up numeric field shown during the tool start.

Select/Deselect First/Last

Mode: Edit mode

Hotkey: None

Menu: Select » Select/Deselect First, Select » Select/Deselect Last

These commands will toggle the selection of the first or last control point(s) of the curve(s) in the object. Useful to quickly find the start of a curve (e.g. when using it as path...).

Select Next/Previous

Mode: Edit mode

Hotkey: None

Menu: Select » Select Next, Select » Select Previous

These commands will select the next or previous control point(s), based on current selection (i.e. the control points following or preceding the selected ones along the curve).

More and Less

Mode: Edit mode

Hotkey: Ctrl+ NumPad/Ctrl- NumPad

Menu: Select » More/Less

These two options are complementary and similar to [those for meshes](#). Their purpose, based on current selected control points, is to reduce or enlarge this selection.

The algorithm is the same as with meshes, but results are more easy to understand:

- More: for each selected control point, select **all** its linked points (i.e. one or two...).
- Less: for each selected control point, if **all** points linked to this point are selected, keep it selected. For all other selected control points, de-select them.

This implies two points:

- First, when **all** control points of a curve are selected, nothing will happen (as for Less, all linked points are always selected, and of course, More can't add any). Conversely, the same goes when no control point is selected.
- Second, these tools will never “go outside” of a curve (they will never “jump” to another curve in the same object).

Page status ([reviewing guidelines](#))

Partial page

Images some screenshots are correct, but taken from the 2.4

Proposed fixes: none

Curve Deform

Curve Deform provides a simple but efficient method of defining a deformation on a mesh. By parenting a mesh object to a curve, you can deform the mesh up or down the curve by moving the mesh along, or orthogonal to, the dominant axis. This is a most useful tool to make an object follow a complex path, like e.g. a sheet of paper inside a printer, a film inside a camera, the water of a canal...

The Curve Deform works on a (global) dominant axis, X, Y, or Z. This means that when you move your mesh in the dominant direction, the mesh will traverse along the curve. Moving the mesh in an orthogonal direction will move the mesh object closer or further away from the curve. The default settings in Blender map the Y axis to the dominant axis. When you move the object beyond the curve endings the object will continue to deform based on the direction vector of the curve endings.

If the “curve path” is 3D, the Tilt value of its control points will be used (see the [Extrusion](#) section above) to twist the “curved” object around it. Unfortunately, the other Radius property is not used (it would have been possible, for example, to make it control the size of the “curved” object...).



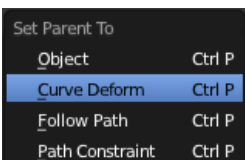
A Tip

Try to position your object over the curve immediately after you have added it, before adding the curve deform. This gives the best control over how the deformation works.

Use modifiers!

The Curve Deform relationship is now also a modifier, called [Curve](#). The Curve modifier function acts the same as its counterpart, except that when the modifier is used, the “dominant axis” is set inside its properties – and the Track X/Y/Z buttons have no more effect on it. And you have some goodies, like the possibility, if “curving” a mesh, to only curve one of its vertex groups...

Interface



Make Parent menu.

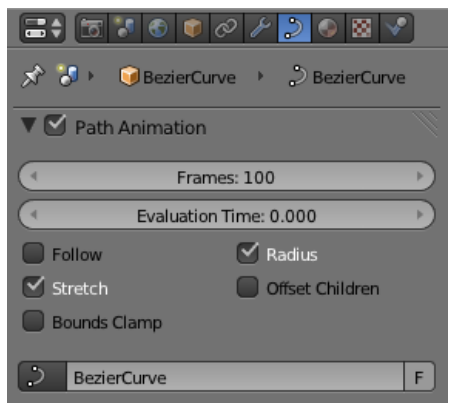
When parenting an object (mesh, curve, meta, ...) to a curve (CtrlP), you will be presented with a menu (*Make Parent menu*).

By selecting Curve Deform, you enable the curve deform function on the mesh object.



Anim settings panel.

The dominant axis setting is set on the mesh object. By default the dominant axis in Blender is Y. This can be changed by selecting one of the Track X, Y or Z buttons in the Anim Panel, (*Anim settings panel*), in Object context (F7).



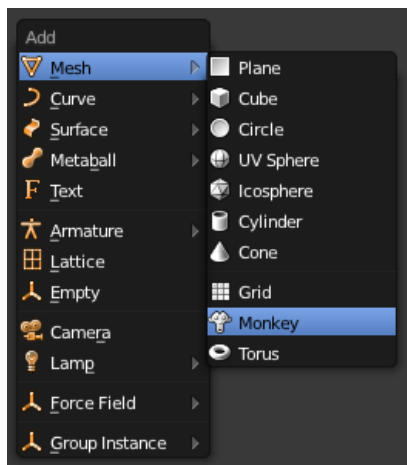
Curve and Surface panel.

Cyclic (or closed) curves work as expected where the object deformations traverse along the path in cycles. Note however than when you have more than one curve in the “parent” object, its “children” will only follow the first one.

The Stretch curve option allows you to let the mesh object stretch, or squeeze, over the entire curve. This option is in Editing Context (F9), for the “parent” curve. See (*Curve and Surface panel*).

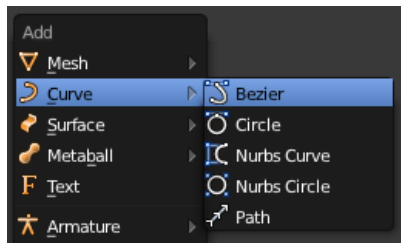
Example

Let’s make a simple example:



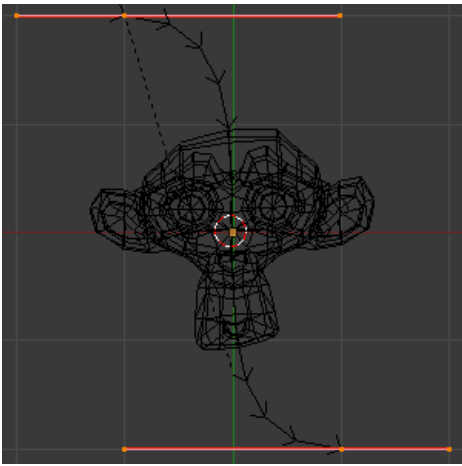
Add a Monkey!

- Remove default cube object from scene and add a Monkey (⇧ ShiftA » Add » Mesh » Monkey, *Add a Monkey!*)!
- Press ⇐ Tab to exit Edit mode.



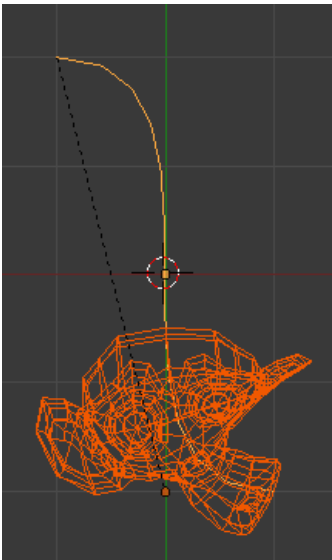
Add a Curve.

- Now add a curve (⇧ ShiftA » Add » Curve » Bezier Curve, *Add a Curve*).



Edit Curve.

- While in Edit mode, move the control points of the curve as shown in (*Edit Curve*), then exit Edit mode (⇐ Tab).



Monkey on a Curve.

- Now, you can use the new, modern, modifier way of “curving” the Monkey:
 - Select the Monkey (RMB).
 - In the Editing context (F9), Modifiers panel, add a Curve modifier.
 - Type the name of the curve (should be “Curve”) in the Ob field of the modifier, and optionally change the dominant axis to Y.
- Or you can chose the old, deprecated method (note that it creates a “virtual” modifier...):
 - Select the Monkey (RMB), and then shift select the curve (⇧ Shift RMB .
 - Press CtrlP to open up the Make Parent menu.
 - Select Curve Deform (*Make Parent menu*).
- The Monkey should be positioned on the curve, as in (*Monkey on a Curve*).
- Now if you select the Monkey (RMB) and move it (G), in the Y-direction (the dominant axis by default), the monkey will deform nicely along the curve.

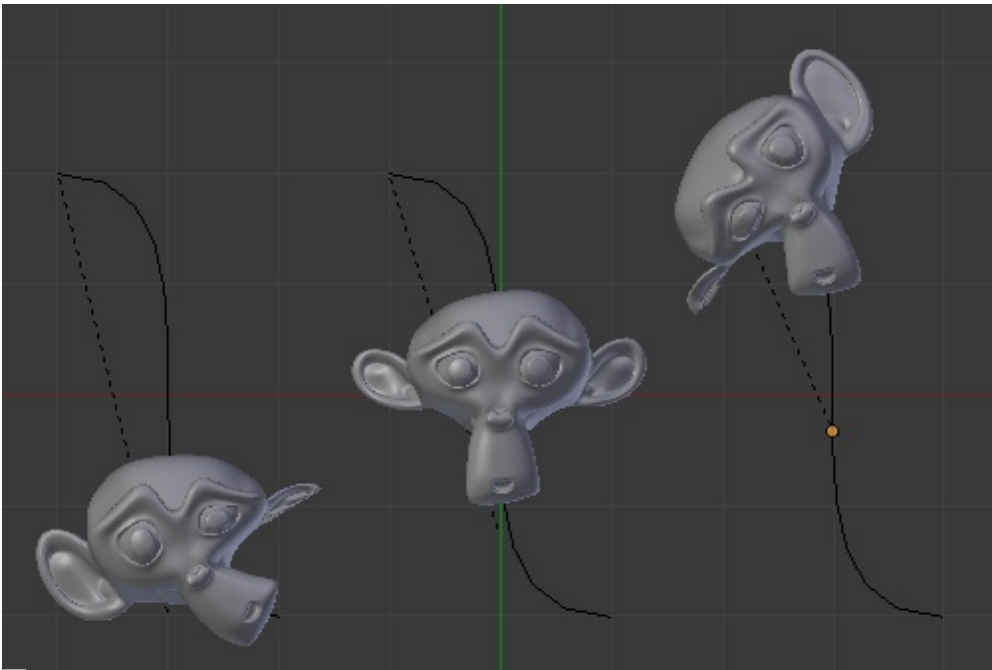
A Tip

If you press MMB (or one of the X/Y/Z key) while moving the Monkey you will constrain the movement to one axis only.

- In (*Monkey deformations*), you can see the Monkey at different positions along the curve. To get a cleaner view over the deformation I have activated SubSurf with Subdiv to 2, and Set Smooth on the Monkey mesh (F9 to get Editing context).

A Tip

Moving the Monkey in directions other than the dominant axis will create some odd deformations. Sometimes this is what you want to achieve, so you'll need to experiment and try it out!



Monkey deformations.

Curve Extrusion

This section covers methods for extruding curves, or giving them thickness, and how to control the thickness along the path

Extrusion

Mode: Object or Edit mode

Panel: Curve and Surface (Editing context, F9)

Ah! The extrusion! Probably the most interesting tool of the curves for modeling, especially with the bevel/taper/Tilt/Radius options... Note that this has nothing to do with the Extrude (E) command, described in the [previous page](#)!

We will see the different settings, depending on their scope of action:

Width

This controls the position of the extruded “border” of the curve, relative to the curve itself. With closed 2D curves (see below), it is quite simple to understand it – with a Width higher than **1.0**, the extruded volume is wider, with a Width of **1.0**, the border tightly follows the curve, and with a Width lower than **1.0**, the volume is narrower... The same principle remains for open 2D and 3D curves, but the way the “outside” and “inside” of the curve is determined seems a bit odd... It has the same effect with extruded “bevel” object...

Tilt

This setting – unfortunately, you can never see its value anywhere in Blender – controls the “twisting angle” around the curve for each point – so it is only relevant with 3D curves!

You set it using the Tilt transform tool (T, or Curve » Transform » Tilt), and you can reset it to its default value (i.e. perpendicular to the original curve plane) with AltT (or Curve » Control Points » Clear Tilt).

With NURBS, the tilt is always smoothly interpolated. However, with Bézier, you can choose the interpolation algorithm to use in the Tilt Interpolation drop-down list of the Curve Tools panel (you will find the classical Linear, Cardinal, B Spline and Ease options...).

Simple Extrusion

Let’s see first the “simple” extrusion of curves, without additional bevel/taper objects.

Extrude

This controls the width (or high) of the extrusion. The real size is of course dependent on the scale of the underlying object, but with a scale of one, an Extrusion of **1.0** will extrude the curve of one BU in both directions, along the axis perpendicular to the curve’s plane (see below for specificities of 3D curves...).

If set to **0.0**, there is no “simple” extrusion!

Bevel Depth

This will add a bevel to the extrusion. See below for its effects...

Note that the bevel makes the extrusion wider and higher.

If set to **0.0**, there is no bevel (max value: **2.0**).

Bev Resol

Controls the resolution of the bevel created by a Bevel Depth higher than zero.

If set the **0** (the default), the bevel is a simple “flat” surface.

Higher values will smooth, round off the bevel, similar to the resolution settings of the curve itself...

We have three sub-classes of results, depending on whether the curve is open or closed or 3D:

Open 2D Curve

The extrusion will create a “wall” or “ribbon” following the curve shape. If using a Bevel Depth, the wall becomes a sort of slide or gutter. Note the direction of this bevel is sometimes strange and unpredictable, often the reverse of what you would get with the same curve closed... You can inverse this direction by [switching the direction](#) of the curve.

All this allows you e.g. to quickly simulate a marble rolling down a complex slide, combining an extruded beveled curve, and a sphere with a Follow Path constraint set against this curve...

Closed 2D Curve

This is probably the most useful situation, as it will quickly creates a volume, with (by default) two flat and parallel surfaces filling the two sides of the extruded “wall”. You can remove one or both of these faces by disabling the Back and/or Front toggle buttons next to the 3D one.

The optional bevel will always be “right-oriented” here, allowing you to smooth out the “edges” of the volume.

3D Curve

Here the fact that the curve is closed or not has no importance – you will never get a volume with an extruded 3D curve, only a wall or ribbon, like with open 2D curves.

However, there is one more feature with 3D curves: the Tilt of the control points (see above). It will make the ribbon to twist around the curve... to create a Möbius strip, for example!

Advanced Extrusion

These extrusions use one or two additional curve objects, to create very complex organic shapes.

To enable this type of extrusion, you have to type a valid curve object name in the BevOb field of the curve you are going to use as the “spinal column” of your extrusion. The “bevel” curve will control the cross section of the extruded object. Whether the BevOb curve is 2D or 3D has no importance, but if it is closed, it will create a “tube-like” extrusion, else you will get a sort of gutter or slide object...

The object is extruded along the whole length of all internal curves. By default, the width of the extrusion is constant, but you have two ways to control it, the Radius property of control points, and the “taper” object.

The Radius of the points is set using the Shrink/Fatten Radius transform tool (AltS, or Curve » Transform » Shrink/Fatten Radius), or with the Set Radius entry in the Specials menu (W). Here again, you unfortunately cannot visualize anywhere the Radius of a give control point...

The Radius allows you to directly control the width of the extrusion along the “spinal” curve. As for Tilt (see above), you can chose the interpolation algorithm used for Bézier curves, in the Radius Interpolation drop-down list of the Curve Tools panel.

But you have another, more precise option: the “taper” object. As for the “bevel” one, you set his name in the TaperOb field of the main curve – it must be an *open curve*. The taper curve is evaluated along *the local X axis*, using *the local Y axis* for width control. Note also that:

- The taper is applied independently to all curves of the extruded object.
- Only the first curve in a TaperOb is evaluated, even if you have several separated segments.
- The scaling starts at the first control-point on the left and moves along the curve to the last control-point on the right.
- Negative scaling, (negative local Y on the taper curve) is possible as well. However, rendering artifacts may appear.
- It scales the width of normal extrusions based on evaluating the taper curve, which means sharp corners on the taper curve will not be easily visible. You'll have to heavily level up the resolution (DefResolu) of the base curve.
- With closed curves, the taper curve in TaperOb acts along the whole curve (perimeter of the object), not just the length of the object, and varies the extrusion depth. In these cases, you want the relative height of the TaperOb Taper curve at both ends to be the same, so that the cyclic point (the place where the endpoint of the curve connects to the beginning) is a smooth transition.

Last but not least, with 3D “spinal” curves, the Tilt of the control points can control the twisting of the extruded “bevel” along the curve!

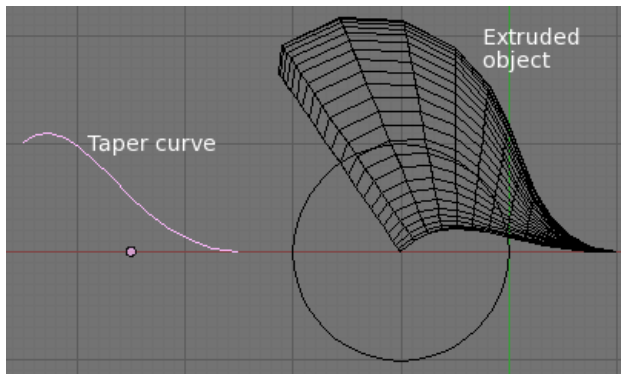
Examples

TODO: add some “simple” extrusion examples.

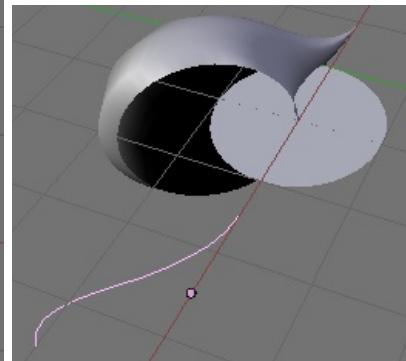
TODO: add some “bevel” extrusion with Radius examples.

Let's taper a simple curve circle extruded object using a taper curve. Add a curve, exit Edit mode, add another one (a closed one, like a circle), call it "BevelCurve", and enter its name in the BevOb field of the first curve (Editing context F9, Curve and Surface panel). We now have a pipe. Add a third curve while in Object mode and call it "TaperCurve". Adjust the left control-point by raising it up about 5 units.

Now return to the Editing [context](#), and edit the first curve's TaperOb field in [Curve and Surface](#) panel to reference the new taper curve which we called "TaperCurve". When you hit enter the taper curve is applied immediately with the results shown in (*Taper extruded curve*).

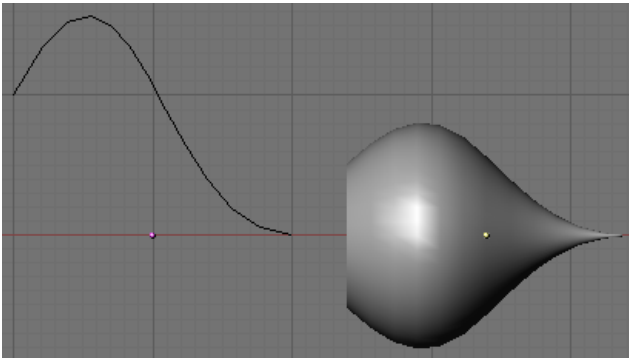


Taper extruded curve.



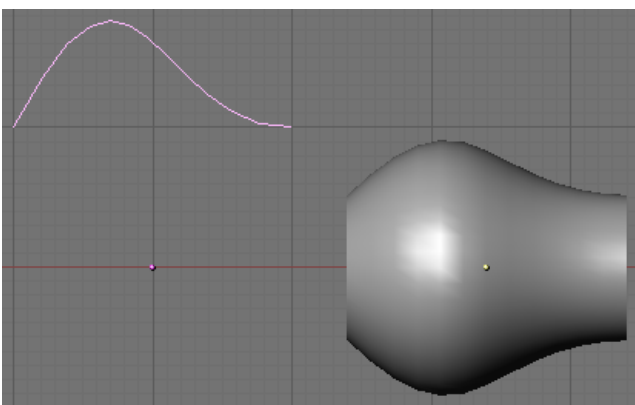
Taper solid mode.

You can see the **taper curve** being applied to the **extruded object**. Notice how the pipe's volume shrinks to nothing as the taper curve goes from left to right. If the taper curve went below the local Y axis the pipe's inside would become the outside which would lead to rendering artifacts. Of course as an artist that may be what you are looking for!



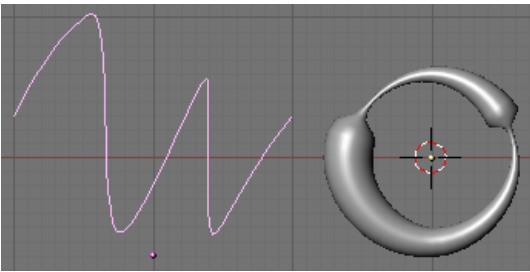
Taper example 1.

In (*Taper example 1*) you can clearly see the effect the left taper curve has on the right curve object. Here the left taper curve is closer to the object center and that results in a smaller curve object to the right.



Taper example 2.

In (*Taper example 2*) a control point in the taper curve to the left is moved away from the center and that gives a wider result to the curve object on the right.



Taper example 3.

In (*Taper example 3*), we see the use of a more irregular taper curve applied to a curve circle.

TODO: add some “bevel” extrusion with Tilt examples.

Page status ([reviewing guidelines](#))

Images

image not correct

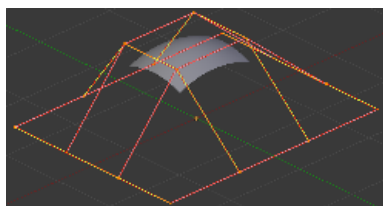
we can't see point labeled C (see the 2.4 version

NurbsSurfaceWeightExample.png

Surface Weight 5.

Proposed fixes: none

Surfaces



Surface.

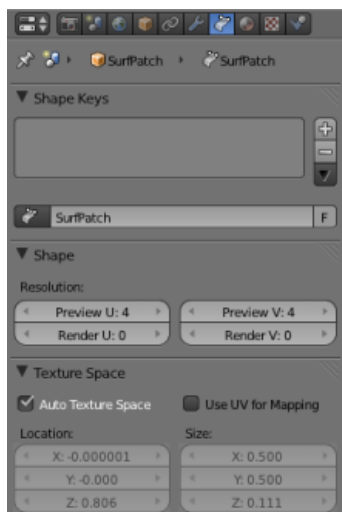
Curves are 2D objects, and surfaces are their 3D extension. Note however that in Blender, you only have NURBS surfaces, no Bézier (you have the Bezier knot type, though, see below), nor polygonal (but for these, you have meshes!). Even though curves and surfaces share the same object type (with texts also...), they are not the same thing, for example, you cannot have in the same object both curves and surfaces.

As surfaces are 2D, they have two interpolation axis, U (as for curves) and V. It is important to understand that *you can control the interpolation rules (knot, order, resolution) independently for each of these two dimensions* (the U and V fields for all these settings, of course).

You may ask yourself “but the surface appears to be 3D, why is it only 2D?”. In order to be 3D the object needs to have “Volume” and a surface, even when it is closed, doesn’t have a volume, it is infinitely thin. If it has a volume the surface would have a thickness (its third dimension). Hence, it’s only a 2D object, and has only two interpolation dimensions or axis or coordinates (if you know a bit maths, think of the non-euclidean geometry – well surfaces are just non-euclidean 2D planes...). To take a more “real life” example, you can roll a sheet of paper to create a cylinder, well, even if it “draws” a volume, the sheet itself will remain a (nearly...) 2D object!

In fact, surfaces are very similar to the results you get when [extruding a curve](#) (by the way, I think it should be possible to convert an extruded curve in a surface, at least when only made of NURBS – but Blender cannot do it currently...).

Finding Surface Tools



Surface Tools.

The panels of the Editing context are the same as for [curves](#), with just fewer options... And as usual, you have the Select and Surface menus in the 3D view headers, and the Specials (W) pop-up one.

Visualization

There is nearly no difference with NURBS curves, except that the u direction is indicated by yellow grid lines, and the v one is materialized by pink grid lines, as you can see in ([Surface](#)).

You can [hide and reveal](#) control points just as with curves, and you have the same draw options in the [Curve Tools](#) panel.

Surface Structure

Many of the concepts from [curves](#), especially [NURBS](#) ones, carry directly over to NURBS surfaces, such as control-points, Order, Weight, Resolution, etc. Here we will just talk about the differences.

It is very important to understand the difference between NURBS curves and NURBS surfaces: the first one has one dimension, the later has two. Blender internally treats NURBS surface and NURBS curves completely differently. There are several attributes that separate them but the most important is that a NURBS curve has a single interpolation axis (U) and a NURBS surface has two interpolation axes (U and V).

However, you can have “2D” surfaces made of curves (using the [extrusion tools](#), or, to a lesser extent, the filling of closed 2D curves. And you can have “1D” curves made of surfaces, as a NURBS surface with only one row (either in U or V direction) of control points produces only a curve...

Visually you can tell which is which by entering Edit mode and looking at the 3D window's header: either the header shows “Surface” or “Curve” as one of the menu choices. Also, you can [extrude](#) a whole NURBS surface curve to create a surface, but you can't with a simple NURBS curve (we talk here about the “standard” Extrude tool, the one activated with the E shortcut, not the quite specific curve extrusion tools – yes, I know, it's not easy to follow...).

Control Points, Rows and Grid

Control points for NURBS surfaces are the same as for NURBS curves. However, their layout is quite constraining. The concept of “segment” disappears, replaced by “rows” and the overall “grid”.

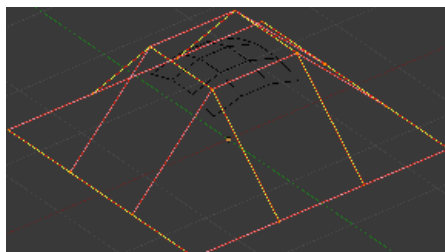
A “row” is a set of control points forming one “line” in one interpolation direction (a bit similar to [edge loops](#) for meshes). So you have “U-rows” and “V-rows” in a NURBS surface. The key point is that *all rows of a given type (U or V) have the same number of control points*. Each control point belongs to exactly one U-row and one V-row.

All this forms a “grid”, or “cage”, of which shape controls the shape of the NURBS surface. A bit like [lattice](#)...

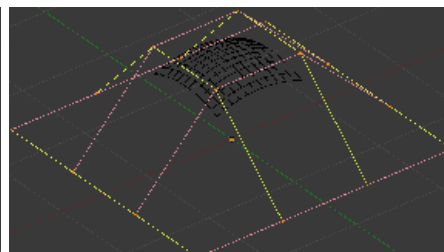
This is very important to grasp: you cannot add a single control point to a NURBS surface, you have to add a whole U- or V-row at once (in practice, you will usually use the extrude tool, or perhaps the duplicate one, to add those...), containing exactly the same number of points as the others. This also means that you will only be able to “merge” different pieces of surfaces if at least one of their rows match together.

Surface Resolution

Just like [NURBS curves](#), Resolution controls the detail of the surface. The higher the Resolution the more detailed and smoother the surface is. The lower the Resolution the rougher the surface. However, here you have two resolution settings, one for each interpolation axis (U and V). Note that unlike with curves, you have only one resolution (the Resol U and V fields, in the Curve Tools panel)...



Resolution 1x1.



Resolution 3x3.

(*Resolution 1x1*) is an example of a surface resolution of 3 for both u and v . (*Resolution 3x3 surface*) is an example of a surface resolution of 12 for both u and v .



Resolution panel.

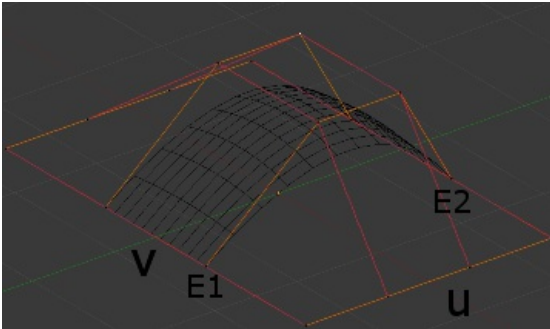
you can adjust the resolution for both preview and render, to don't slow things down in the viewport, but stil get good render results.

Closed and Open Surfaces

As curves, surfaces can be closed (cyclical) or opened, independently in both directions, allowing you to easily create a tube, donut or sphere shape, and they can be drawn as “solids” in Edit mode. This makes working with surfaces quite easy.

Knots

Just like with [NURBS curves](#), NURBS surfaces have two knot vectors, one for each U and V axis. Here again, they can be one of Uniform, Endpoint, or Bezier, with same properties as for curves. And as with curves, only opened surfaces (in the relevant direction) are affected by this setting...



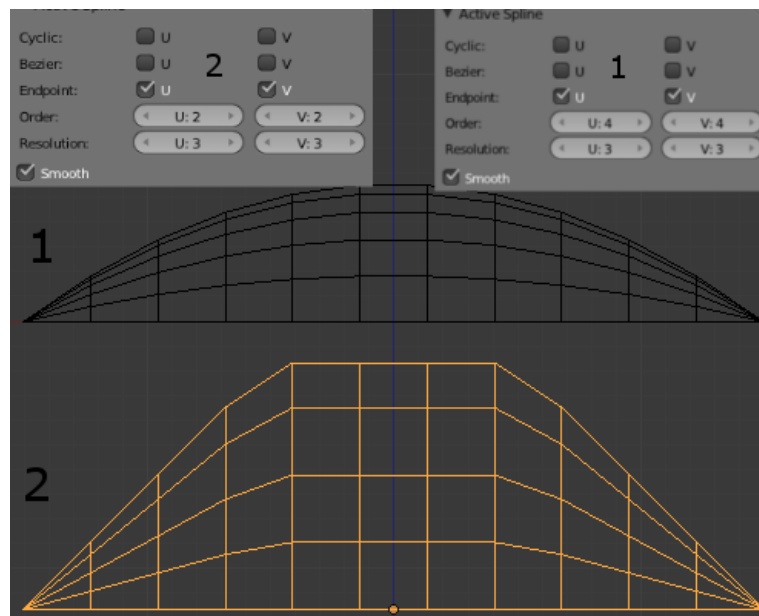
Endpoint U.

In (*Endpoint U*), the U interpolation axis is labeled as “u” and the V interpolation axis is labeled as “v”. The u’s interpolation axis has been set to Endpoint and as such the surface now extends to the outer edges from “E1” to “E2” along the u interpolation axis.

To cause the surface to extend to all edges you would set the v’s axis to Endpoint as well.

Order

One more time, this property is the same as with [NURBS Curves](#), it specifies how much the control-points are taken into account for calculating the curve of the surface shape. For high Orders, (1), the surface pulls away from the control-points creating a smoother surface – assuming that the [resolution](#) is high enough. For lowest Orders, (2), the surface follows the control-points, creating a surface that tends to follow the grid cage.

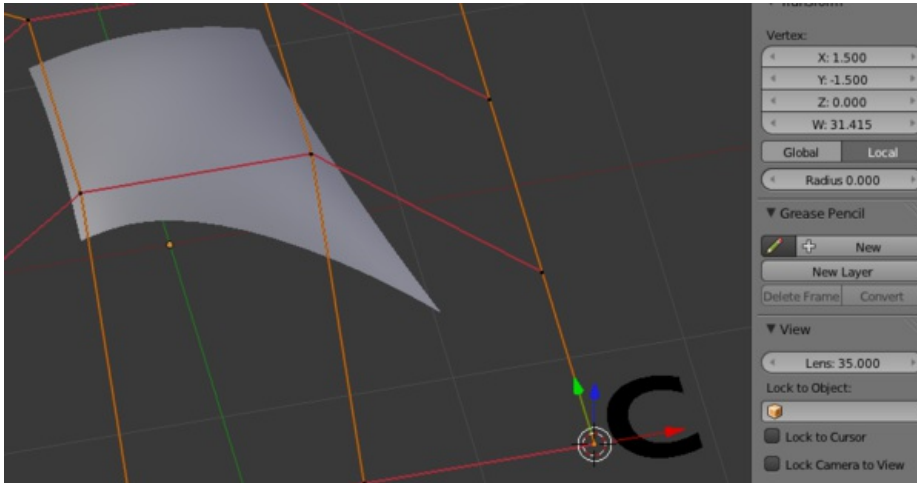


Order 2 and order 4 surface.

For illustration purposes, in both (*Order 4 surface*) and (*Order 2 surface*), the knot vectors were set to Endpoint causing the surface to extend to all edges.

You can set independently the order for each interpolation axis, and as for curves, it cannot be lower than **2**, and higher than **6** or the number of control points on the relevant axis.

Weight



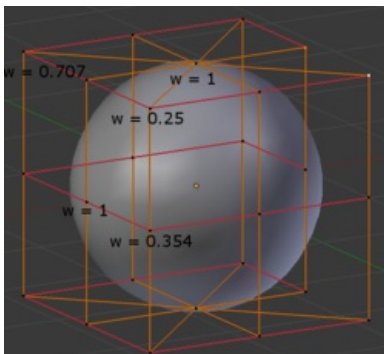
Guess what? Yes, it works exactly as with [NURBS Curves](#)! Weight specifies how much each control-point “pulls” on the curve.

In (*Surface Weight 5*), a single control-point, labeled “c”, has had its Weight set to **5.0** while all others are at their default of **1.0**. As you can see that control-point *pulls* the surface towards it.

If all the control-points have the same Weight then each effectively cancels each other out. It is the difference in the weights that cause the surface to move towards or away from a control-point.

The Weight of any particular control-point is visible in the [Transform Properties panel](#) (N), in the *W field* (and not the Weight field...).

Preset Weights



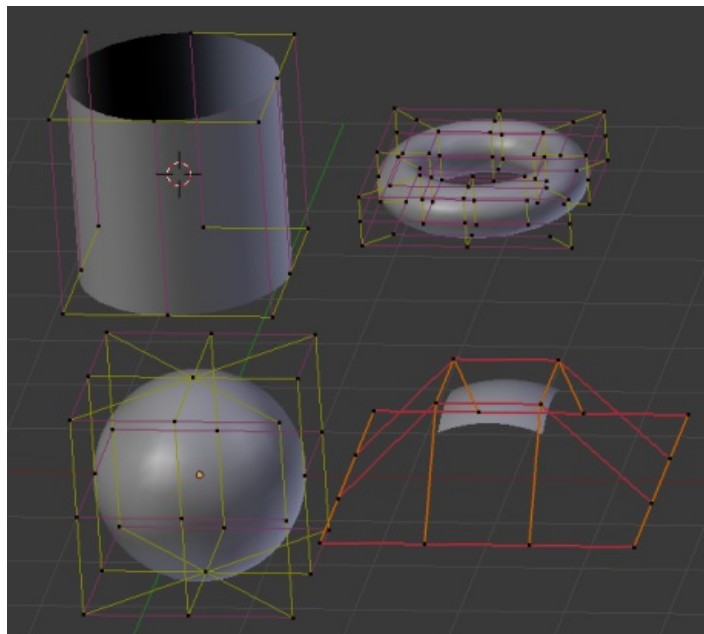
A sphere surface.

NURBS can create pure shapes such as circles, cylinders, and spheres (note that a Bézier circle is not a pure circle). To create pure circles, globes, or cylinders, you must set to specific values the weights of the control-points – some of which are provided as presets in the Curve Tools panel (lower right corner). This is not intuitive, and you should read more on NURBS before trying this.

We saw with 1D [NURBS curves](#) how to create a circle, let’s see how to create a sphere with 2D surfaces. It is the same principle – you’ll note that the four different weights needed for creating a sphere (**1.0**, **0.707** = $\sqrt{0.5}$, **0.354** = $\sqrt{2}/4$, and **0.25**) are the four presets available in the [Curve Tools](#) panel...

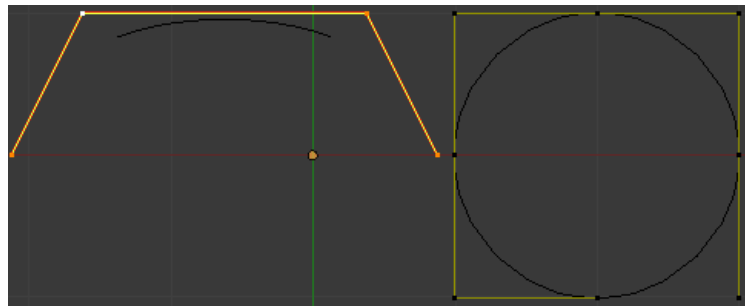
Primitives

To help get started in creating surfaces there are four preset NURBS surfaces, found in the Add » Surface menu: NURBS Surface, NURBS Tube, NURBS Sphere and NURBS Torus.



NURBS surface primitives.

There are also two preset NURBS surface curves (with only one control point on each V-row): NURBS Curve and NURBS Circle.



NURBS curve primitives.

Note how circle NURBS surface is never filled, unlike its “real” curve counterpart...



Page status ([reviewing guidelines](#))

Proposed split

Text split selection and editing

Proposed fixes: none

Surface Selection

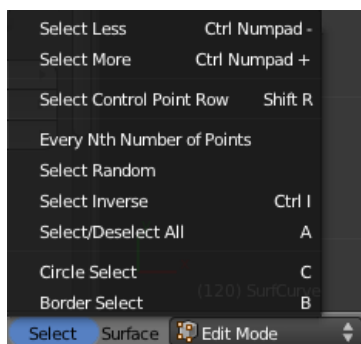
Surface selection in Edit mode is very similar to [NURBS curve selection](#). The basic tools are the same as with [meshes](#), so you can select a simple control point with a LMB -click, add to current selection with ⇧ Shift LMB -clicks, Border-select, and so on.

L (or CtrlL) will add to the selection the mouse cursor's nearest control point, and all the linked ones, i.e. all points belonging to the same surface.

Select Menu

The Select menu (3D view headers) is even simpler than for curves...

All these options have the same meaning and behavior as in [Object mode](#) (and the specificities of Border Select in Edit mode have already been discussed [here](#)).



Every Nth

Mode: Edit mode

Hotkey: None

Menu: Select » Every Nth

This is the same option as for [curve selection](#). However, the behavior of the N ("selection step") parameter in the 2D of a NURBS surface "cage" seems quite difficult to understand...

Control Point Row

Mode: Edit mode

Hotkey: ⇧ ShiftR

Menu: Select » Control Point Row

This option works a bit like [edge loop selection](#) for meshes, inasmuch it selects a whole [row](#) of control points, based on the active (the last selected) one. The first time you hit ⇧ ShiftR, the V-row passing through (containing) the active point will be *added to the current selection*. If you use again this shortcut, you will toggle between the U- and V-row of this point, *removing everything else from the selection*.

More and Less

Mode: Edit mode

Hotkey: Ctrl+ NumPad/Ctrl- NumPad

Menu: Select » More/Less

These two options are complementary and very similar to [those for meshes](#). Their purpose, based on current selected control points, is to reduce or enlarge this selection.

The algorithm is the same as with meshes:

- More: for each selected control point, select **all** its linked points (i.e. two, three or four).
- Less: for each selected control point, if **all** points linked to this point are selected, keep it selected. For all other selected control points, de-select them.

This implies two points:

- First, when **all** control points of a surface are selected, nothing will happen (as for Less, all linked points are always selected, and of course, More can't add any). Conversely, the same goes when no control point is selected.
- Second, these tools will never "go outside" of a surface (they will never "jump" to another surface in the same object).

Surface Editing

Surface editing has even less tools and options than its curve counterpart – and has many common points with it... So this page covers (or tries to cover) all the subjects, from the basics of surface editing to more advanced topics, like retopology.

Basic Surface Editing (translation, rotation, scale)

Mode: Edit mode

Hotkey: G/R/S

Menu: Surface » Transform » Grab/Move, Rotate, Scale, ...

Once you have a selection of one or more control points, you can grab/move (G), rotate (R) or scale (S) them, like many other things in Blender, as described in the [Manipulation in 3D Space](#) section.

You also have in Edit mode an extra option when using these basic manipulations: the [proportional editing](#).

Advanced Transform Tools

Mode: Edit mode

Menu: Surface » Transform

The To Sphere, Shear, Wrap and Push/Pull transform tools are described in the [Mesh Editing](#) chapter. Surfaces have no specific transform tools.

NURBS Control Points Settings

Mode: Edit mode

Panel: Curve Tools (Editing context, F9), and Transform Properties


We saw in a [previous page](#) that NURBS control points have a weight, which is the influence of this point on the surface. You set it either using the big Set Weight button in the Curve Tools panel (after having defined the weight in the numeric field to the right), or by directly typing a value in the W numeric field of the Transform Properties panel.

Adding or Extruding

Mode: Edit mode

Hotkey: E (or Ctrl LMB )

Menu: Surface » Extrude


Unlike meshes or curves, you cannot generally directly add new control points to a surface (with Ctrl LMB  clicks), as you can only extend a surface by adding a whole U- or V-row at once. The only exception is when working on a NURBS surface curve, i.e. a surface with only one control point on each U- or V-row. In this special case, all works exactly as with [curves](#).

Most of the time, only extrusion is available. As usual, once the tool is activated the extrusion happens immediately and you are placed into Grab mode, ready to drag the new extruded surface to its destination.

There are two things very important to understand:

- Surfaces are **2D** objects – so you can't extrude anything *inside* a surface (e.g. "inner" row), it wouldn't make any sense!
- The control "grid" *must remain "squarish"*, which means that you can only extrude a whole row, not parts of rows here and there...

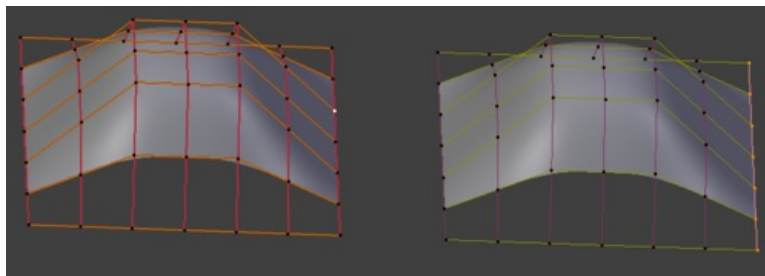
To summarize, the Extrude tool will only work when one and only one whole border row is selected – else nothing happens.

As for curves, you cannot create a new surface in your object out of nowhere, by just Ctrl LMB -clicking with nothing selected. However, unlike for curves, there is no "cut" option allowing you to separate a surface in several parts, so you only can create a new surface by [copying](#) an existing one (⇧ ShiftD), or adding a new one (Add menu...).

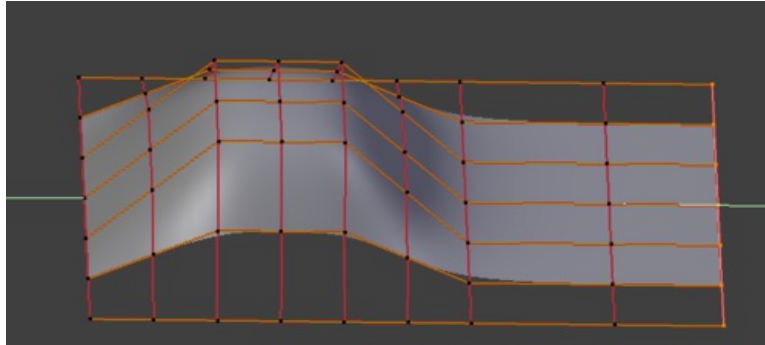
Examples

Images (*Selecting control-point*) to (*Complete*) show a typical extrusion along the side of a surface.

In (*Selecting control-point*) and (⇧ ShiftR), a border row of control-points were highlighted by selecting a single control-point, labeled "c", and then using the handy row select tool (⇧ ShiftR) to select the rest of the control-points.



The edge is then extruded using the E as shown in (*Extruding*). Notice how the mesh has bunched up next to the highlighted edge; the area in question is highlighted in a light-grey circular area. That is because the *new* extruded surface section is bunched up there as well.



By moving the new section away from the area the surface begins to "unbunch".). The direction of movement is marked with a white arrow, labeled "E", and the new section is labeled "S".

You can continue this process of extruding – or adding – new surface sections until you have reached the final shape for your model.

Opening or Closing a Surface

Mode: Edit mode

Hotkey: C

Menu: Surface » Toggle Cyclic

As [curves](#), surfaces can be closed (cyclic) or opened. However, as surfaces are 2D, you can control this property independently along the U and V axis.

To toggle the cyclic property of a surface along one axis, use C and choose either cyclic U or cyclic V from the [Toggle pop-up menu](#). The corresponding surface's outer edges will join together to form a "closed" surface.

Inner and Outer

Surfaces have an "inner" and "outer" face, the first being black whereas the later is correctly shaded – there does not seem to be any "double sided" shading option for surfaces...). When you close a surface in one or two directions, you might get a whole black object! In this case, just [switch the "direction"](#) of your surface...

Duplication

Mode: Edit mode

Hotkey: ⇧ ShiftD

Menu: Curve » Duplicate

Well, as with meshes and curves, this command just duplicates the selection. As usual, the copy is selected and placed in Grab mode, so you can move it to another place.

However, with surfaces there are some selections that can't be duplicated, in which case they will just be placed in Grab mode... In fact, only selections forming a *single valid sub-grid* are copyable, let's see this in practice:

- You can copy a single control point. From it, you will be able to “extrude” a “surface curve” along the U axis, and then extrude this unique U-row along the V axis to create a real new surface.
- You can copy a single continuous part of a row (or a whole row, of course). This will give you a new **U-row**, even if you selected (part of) a V-row!
- You can copy a single whole sub-grid.

Note that trying to duplicate several valid “sub-grids” (even being single points) at once won't work, you'll have to do it one after the other...

Deleting Elements

Mode: Edit mode

Hotkey: X or Del

Menu: Curve » Delete...

The Erase pop-up menu of surfaces offers you two options:

Selected

This will delete the selected rows, *without* breaking the surface (i.e. the adjacent rows will be directly linked, joined, once the intermediary ones are deleted). The selection must abide the following rules:

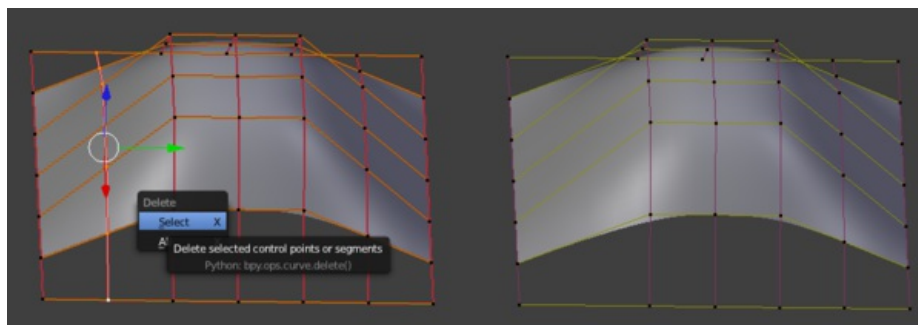
- Whole rows, and only whole rows must be selected.
- Only rows along the same axis must be selected (i.e. you can't delete both U- and V-rows at the same time).

Also remember that NURBS order cannot be higher than its number of control points in a given axis, so it might decrease when you delete some control points... Of course, when only one row remains, the surface becomes a “surface curve”, when only one point remains, there is no more visible surface, and when all points are deleted, the surface itself is deleted.

All

As with meshes or curves, this deletes everything in the object!

Example



Before and after

In (*Before*) a row of control-points have been selected by initially selecting the control-point labeled “A” and using ⇧ ShiftR to select the remaining control-points. Then, using the [Erase menu](#) (X), the *selected* row of control-points is erased resulting in (*After*).

Joining or Merging Surfaces

Mode: Edit mode

Hotkey: F

Menu: Surface » Make Segment

Just like [curves](#), merging two surfaces requires that a single edge, a border row of control-points, from two separate surfaces are selected. This means that the surfaces must be part of the same object. For example, you can't join two surfaces while in Object mode – but you can of course, as with any objects of the same type, [join two or more Surface objects](#) into one object (CtrlJ) – they just won't be "linked" or merged in a single one... Yes, it's a bit confusing!

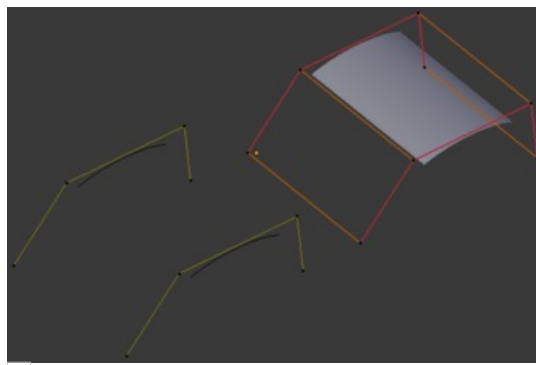
This command is equivalent to creating edges or Faces for meshes (hence it's shortcut), and so it only works in Edit mode. The selection must contain only border rows of the same resolution (with the same number of control points), else Blender will try to do its best to guess what to merge with what, or the merge will fail (either silently, or stating that "Resolution doesn't match" if rows with different number of points are selected, or that there is "Too few selections to merge" if you only selected points in one surface...

So to avoid problems, you should always only select border rows with same number of points... Note that you can join a border U-row of one surface with a border V-row of another one, Blender will automatically "invert" the axis of one surface for them to match correctly.

NURBS surface curves are often used to create objects like hulls, as they define cross sections all along the object, and you just have to "skin" them as described above to get a nice, smooth and harmonious shape. See [this tutorial](#) for a detailed workflow.

Examples

(*Joining ready*) is an example of two NURBS surface curves, **not** NURBS curves, in Edit mode, ready to be joined. (*Joining complete*) is the result of joining the two curves.



Joining ready.

Subdivision

Mode: Edit mode

Panel: Curve Tools1 (Editing context, F9)

Hotkey: W » 1 NumPad

Menu: Surface » Segments » Subdivide, Specials » Subdivide

Surface subdivision is most simple: using either the Subdivide entry in the Specials menu (W), or the Subdivide button of the Curve Tools1 panel, you will subdivide once all *completely selected grids* by subdividing each "quad" in four smaller ones.

If you apply it to a 1D surface (a "surface curve"), this tool works exactly as with [curves](#).

Spin

Mode: Edit mode

Panel: Curve Tools1 (Editing context, F9)

This tool is a bit similar to its [mesh counterpart](#) – but with less control and options (in fact, there's none!).

It only works on selected "surfaces" made of *one U-row* (and not with one V-row), so called "surface curves", by "extruding" this "cross section" in a square pattern, automatically adjusting the weights of control points to get a perfect circular extrusion (this also implies closing the surface along the V axis), following exactly the same principle as for the NURBS Tube or NURBS Donut primitives.

Switch Direction

Mode: Edit mode

Hotkey: W » 2 NumPad

Menu: Surface » Segments » Switch Direction, Specials » Switch Direction

This command will “reverse” the direction of any curve with at least one selected element (i.e. start point will begin end one, and *vice-versa*). Mainly useful when using curve as path, or the bevel and taper options...

Other Specials Options

Mode: Edit mode

Hotkey: W

Menu: Specials

The Specials menu contains exactly the same additional options as for [curves](#) – but I suppose Set Radius and Smooth Radius have nothing to do here...

Conversion

As there are only NURBS surfaces, there is no “internal” conversion here.

However, there is an “external” conversion available, from surface to mesh, that only works in Object mode. It transforms a Surface object in a Mesh one, using the surface resolution in both directions to create faces, edges and vertices.

Retopology

Snapping surface components is the same as is with meshes and curves. See [Retopology](#) for more information.

Misc Editing

You have some of the same options as with meshes, or in Object mode. You can [separate](#) a given surface (P), make other selected objects [children](#) of one or three control points (CtrlP – note however that parenting to three control points has a strange behavior with curves...), or [add hooks](#) to control some points with other objects.

The Mirror tool is also available, behaving exactly as with [mesh vertices](#).

Page status ([reviewing guidelines](#))

Proposed split

Text split here http://wiki.blender.org/index.php/Doc:2.5/Manual/Modeling/Texts#Text_Boxes

Proposed fixes: none

Texts

Mode: Edit mode (Text)

Panel: Curve and Surface, Font and Char (Editing context, F9)

Hotkey: F9

Menu: Add » Text



☐ Text Examples.

Text objects are exactly what they mean, they contain some text. They share the same object type as curves and surfaces, as modern fonts (OpenType, TrueType, etc.) are vectorial, made of curves (generally Béziers).

Blender uses a “Font System” to manage the mapping “letter codes → objects representing them in 3D views”. This implies that not only does the font system have its own *built-in* font, but it can use external fonts too, including *PostScript Type 1*, *OpenType* and *TrueType* fonts. And last but not least, it can use any objects existing in current .blend file as letters...

Texts in Blender allow you to create/render 2D or 3D texts, shaded as you want, with various advanced layout options (like justifying and frames), as we will see below. By default, letters are just flat filled surfaces, exactly as any closed 2D curve. But you can of course extrude them... And texts can follow other curves.

Of course, once you are happy with the shape of your text, you can convert it (with AltC, in Object mode), either to a curve, or directly to a mesh, allowing you to use on it all the powerful features of these objects...

(*Text Examples*) shows some examples of various fonts in action including the “blue” font that has been applied to a curve path.

Notes

A maximum of **50000** characters is allowed per text object, however, be forewarned that the more characters a single text object has, the slower the object will respond interactively.

As you can see when you switch between Object and Edit modes, the Font panel remains the same. This means that its settings can be applied indifferently in both modes... and this implies that you cannot apply them to just a part of the mesh. So font, size, and so on, are common to all letters in a Text object. There is just one exception: the Bold/Italic buttons control properties specific to each letter (this is a way to use up to four different fonts in a text).

For optimum resource usage, only characters that are being used consume memory (rather than the entire character set).

Text Selection



Text in Edit mode.

In Edit mode, your text has a white cursor, and as in any text editor, it determines where new chars will be inserted! You move this cursor with the arrow keys (\rightarrow / \downarrow / \leftarrow / \uparrow) or Page up/Page down and \leftarrow Home/ \rightarrow End keys.

Hold \diamond Shift while using the arrow keys to select a part of the text. You can use it to specify different materials, the normal/bold/italic state, and not much more...

Editing Text

Mode: Edit mode

Hotkey: see below



Text in Edit mode.

Editing text is quite different than other object types in Blender, and happens mainly in two areas. First, the 3D view, of course, where you type your text, and have a few shortcuts, e.g. for applying [styles](#) – note however that most Blender hotkeys you know in Edit mode do not exist for texts! The second place is the Button window (Editing context, F9), especially the Font panel.

The menu of the 3D view header has nearly no use, and there is no Specials menu... You have no transform nor mirror tools, and so on. However, you can apply to texts the same modifiers as to curves.

Editing Text is similar to using a standard text editor but is not as full featured and has some differences:

Exit Edit mode

\Leftarrow Tab doesn't insert a tab character in the text, but rather enters and exits Edit mode, as with other object types.

Copy

To copy text to the buffer use CtrlC or the **Copy** button in the tool shelf.

Cut and Copy

To cut and copy text to the buffer use CtrlX or the **Cut** button in the tool shelf.

Paste

To paste text from the buffer use CtrlV or the **Paste** button in the tool shelf.

Delete all text

To completely erase or delete all text use Ctrl \leftarrow Backspace.

Home/End

\leftarrow Home and \rightarrow End move the cursor to the beginning and end of a line respectively.

Next/Previous word

To move the cursor on a word's boundary use Ctrl \leftarrow or Ctrl \rightarrow .

The text buffer does not communicate with the desktop. It only works from within Blender. To insert text from outside Blender see [Inserting text](#) below.

Inserting Text

You can insert text in three different ways: from the internal text buffer ([Editing Text](#)), or from a text file.

To load text from a text file, use the Text » Paste File tool. This will bring up a File Browser window for navigating to a valid UTF-8 file. As usual, be careful that the file doesn't have too many characters as interactive response will slow down.

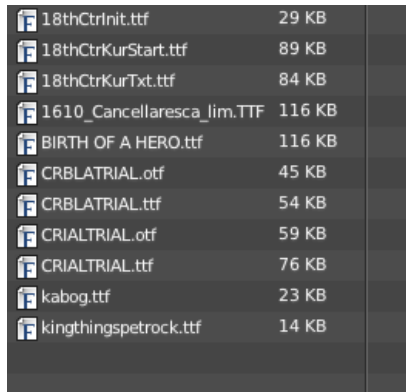
Fonts












Mode: Edit mode

Panel: Font (Editing context, F9)

The Font panel has several options for changing the look of characters.

Loading and Changing Fonts



 18thCtlnit.ttf	29 KB
 18thCtKurStart.ttf	89 KB
 18thCtKurTxt.ttf	84 KB
 1610_Cancellaresca_lim.TTF	116 KB
 BIRTH OF A HERO.ttf	116 KB
 CRBLATRIAL.otf	45 KB
 CRBLATRIAL.ttf	54 KB
 CRIALTRIAL.otf	59 KB
 CRIALTRIAL.ttf	76 KB
 kabog.ttf	23 KB
 kingthingspetrock.ttf	14 KB

Loading a Type 1 font file.

Blender comes with a *built-in* font by default and is displayed in each of the four font style choosers. The *built-in* font is always present and shows in this list as “Bfont”. The first icon contains a drop-down list displaying currently loaded fonts. Select one for each font style.

To load a different Font, click the **Load** button in the and navigating to a *valid* font. The File Browser window will give all valid fonts a capital F icon, as seen in *Loading a Type 1 font file*.

Unix note

Fonts are typically located under `/usr/lib/fonts`, or some variant like `/usr/lib/X11/fonts`, but not always. They may be in other locations as well, such as `/usr/share/local` or `/usr/local/share`, and possibly related sub-trees.

If you select a font that Blender can’t understand, you will get the error “Not a valid font”.

Remember the same font will be applied to all chars with same style in a text, but that a separate font is required for each style. For example, you will need to load an *Italics* font in order to make characters or words italic. Once the font is loaded you can apply that font “Style” to the selected characters or the whole object. In all, you would need to load a minimum of four different types of fonts to represent each style (**Normal**, **Italics**, **Bold**, **Bold-Italics**).

It is important to understand that Blender do not bother what font you load for “normal”, “bold”, etc., style. This is how you can have up to four different fonts in use in the same text – but you have to chose between different styles of a same font, or different fonts.

Objects as Fonts

You can also “create” your own “font” inside Blender! This is a quite complex process, so let’s detail it:

- First, you must create your chars. Each char is an object, *of any type* (mesh, curve, meta...). They all must have a name following the schema: *common prefix* followed by the *char name* (e.g. “ft.a”, “ft.b”, etc.).
- Then, for the Text object, you must enable the Dupli Verts button (Object context – F7 –, Anim Settings panel).
- Back in Editing context (F9), in the Font panel, fill the Ob Family field with the *common prefix* of your “font” objects.

Now, each time a char in your text matches the *suffix part* of a “font” object’s name, this object is duplicated on this char. *The original chars remain visible*. The objects are duplicated so that their center is positioned at the *lower right corner* of the corresponding chars.

Formatting Fonts

Mode: Edit mode

Panel: Font (Editing context, F9)

Blender has a number of typographic controls for changing the style and layout of text, found in the Font panel.

Size

Controls the size of the whole text (no way to control each char size independently). Note however that chars with different fonts (different styles, see below) might have different visible size.



shear: 'blender' has a shear value of 1,
'2.59' a shear value of 0

Shear

Controls the inclination of the whole text. Even if this seems similar to italics style, *this is not the same thing!*

Bold, Italics and Underline



check a character option to, for example,
type bold text

Italics

Toggled with the Italic button before typing. Text can also be set to Italic by selecting it then using the **Italic** button in the Tool Shelf.

Bold

Toggled with the Bold button before typing. Text can also be set to Bold by selecting it then using the **Bold** button in the Tool Shelf.

Bold and Italics

A combination of the two previous styles, but it uses a forth different font.

Underline

Toggled with the Underline button before typing. Text can also be set to Underlined by selecting it then using the **Underline** button in the Tool Shelf.



Bold text.

Small Caps

type small capital text.

Underline position

This allows you to shift vertically the position of the underline.

Underline thickness

This controls the thickness of the underline.

Blender's Bold and Italic buttons don't work the same way as other applications, as they also serve as placeholders for you to load up certain fonts manually, which get applied when you define corresponding style, see [above](#).

To apply the Bold/Italics/Underline attribute to a set of characters you either turn on Bold/Italics/Underline prior to typing characters, or highlight (select) first and then toggle Bold/Italics/Underline.

Setting Case

You can change text case by selecting it then clicking the **To Upper** or **To Lower** in the tool shelf.

Enable the Small Caps option to type characters as small caps.

The size of the Small Caps can be changed with the Small Caps Scale setting. Note that the Small Caps Scale is applied the same to all Small Caps formatted characters.

Alignment

The Paragraph Panel, has settings for the alignment and spacing of text.



the paragraph tab

Align

Left

Aligns text to left of frames when using them, else uses the center point of the Text object as the starting point of the text (which grows to the right).

Center

Centers text in the frames when using them, else uses the center point of the Text object as the mid-point of the text (which grows equally to the left and right).

Right

Aligns text to right of frames when using them, else uses the center point of the Text object as the ending point of the text (which grows to the left).

Justify

Only flushes a line when it is **terminated** by a wordwrap (**not** by ↵ Enter), it uses *whitespace* instead of *character spacing* (kerning) to fill lines.

Flush

Always flushes the line, even when it's still being entered, it uses character spacing (kerning) to fill lines.

Both Justify and Flush only work within frames.

Spacing

Character

A factor by which space between each character is scaled, in width

Word

A factor by which whitespace between words is scaled, in width. You can also control it by selection by pressing Alt← or Alt→ to decrease/increase spacing by steps of **0.1**.

Line

A factor by which the vertical space between lines is scaled.

Offset

X offset and Y offset

Well, these settings control the X and Y offset of the text, regarding its "normal" positioning. Note that with [frames](#), it applies to all frames' content...

Special Characters

Mode: Edit mode

Menu: Text » Special Characters

There are a few special characters that are available using the Alt key or the Text menu on the 3D window header.

Here is a summary of these characters:

AltC:	Copyright (©)	AltR:	Registered trademark (®)
AltG:	Degrees (°)	AltX:	Multiply symbol (×)
AltS:	German “ss” (ß)	AltF:	Currency sign (₣)
AltL:	British Pound (£)	AltY:	Japanese Yen (¥)
Alt1:	Superscript 1 (¹)	Alt2:	Superscript 2 (²)
Alt3:	Superscript 3 (³)	Alt.::	Circle
Alt?:	Spanish question mark (¿)	Alt!:	Spanish exclamation mark (¡)
Alt<:	Left double quotation mark («)	Alt>:	Right double quotation mark (»)

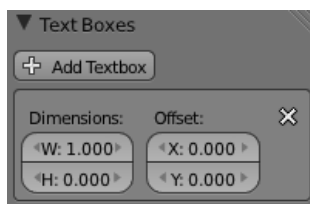
All the characters on your keyboard should work, including stressed vowels and so on. If you need special characters (such as accented chars, which are not there on a US keyboard) you can produce many of them using a combination of two other characters. To do so, type the main char, press Alt← Backspace, and then press the desired “modifier” to produce the special character. Some examples are given below:

A, Alt← Backspace, ~:	ã A, Alt← Backspace, ':	á A, Alt← Backspace, `:	à
A, Alt← Backspace, O:	å E, Alt← Backspace, ":	ë O, Alt← Backspace, /:	ø

Text Boxes

Mode: Object or Edit modes

Panel: Font (Editing context, F9)



Text frame.

Text “Boxes” allow you to distribute the text amongst rectangular areas within a single text object. An arbitrary number of freely positionable and re-sizable text frames are allowed per text object.

Text flows continuously from the lowest-numbered frame to the highest-numbered frame with text inside each frame word-wrapped. Text flows between frames when a lower-numbered frame can’t fit anymore text. If the last frame is reached text overflows out of it.

Text frames are very similar to the concept of *frames* from a desktop publishing application, like Scribus. You use frames to control the placement and flow of text.

Frames are controlled in the Text Boxes panel.

Frame size

By default the first frame for a new text object, and any additional frames, has a size of **zero** for both Width and Height, which means the frame is initially not visible.

frames with a width of **0.0** are ignored completely during text flow (no wordwrap happens) and frames with a height of **0.0** flow forever (no flowing to the next text frame).

In order for the frame to become visible the frame’s Width must be greater than **0.0**.

Note

Technically the height is never actually **0.0** because the font itself always contributes height.



☐ Frame width.

(*Frame width*) is a text object with a width of **5.0**. And because the frame width is greater than **0.0** it is now visible and is drawn in the active theme color as a dashed rectangle. The text has overflowed because the text has reached the end of the last frame, the default frame.

Adding/Deleting a Frame

To add a frame click the **Add Textbox** button on the Text Boxes panel. A new frame is inserted just after (in text flow order) the current one, with its attributes (position and size). Be sure to modify the offset for the new frame in the X and/or Y fields. Just an X modification will create a new column.

To delete the current frame click the **Delete** button. Any text in higher frames will be re-flowed downward into lower frames.

Example: Text Flow



☐ wrapping

With two or more frames you can organize text to a finer degree. For example, create a text object and enter “Blender is super duper”. This text object has a frame, it just isn’t visible because its Width is **0.0**.

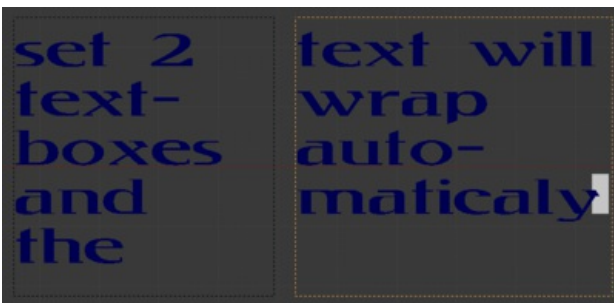
Set the width to **5.0**. The frame is now visible and text is wrapping according to the new width, as shown in (*Text 2*). Notice that the text has overflowed out of the frame. This is because the text has reached the end of the last frame which just happens to be the default/initial frame.



☐ text flowing from box 1 to box 2

When we add another frame and set its width and height the text will flow into the new frame.

Example: Multiple columns



☐ Text 5.

To create two columns of text just create a text object and adjust the initial frame’s Width and Height to your requirements, then insert a new frame. The new frame will have the same size as the initial frame. Set the X position to something greater or less than the width of the initial frame, see (*Text 5*).

Multiple Materials

Mode: Edit mode

Panel: Link and Materials (Editing context, F9)

Each character can have a different Material index in order to have different materials on different characters.

You can assign indices either as you type, or after by selecting blocks of text and clicking on the **Assign** button in the Materials panel.

Examples



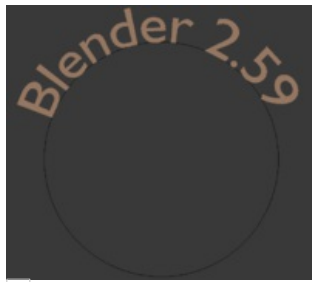
Red Green Blue.

For example to create (*Red Green Blue*) you would need to create three separate materials and three separate material indices. Each word would be assigned a Material index by selecting the characters for each word and clicking the **Assign** button. (*Red Green Blue*) is still one single Text object.

Text on Curve

With the [curve modifier](#) you can let text follow a curve.

Example



Text on curve.

In (*Text on curve*) you can see a text deformed by a curve (a 2D Bézier circle).

to apply the curve modifier, the text object first has to be converted to a mesh, using AltC and click mesh.

Note

there is also a Text on Curve feature, but the curve modifier offers more options.

Curve Display Attributes

Mode: Object or Edit modes

Panel: Curve and Surface (Editing context, F9)

As you can see in the Curve and Surface panel, texts have most of the same options as curves

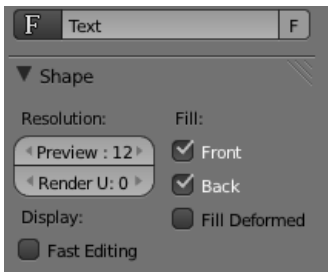
Resolution

Preview

the [resolution](#) in the viewport.

Render

the [resolution](#) on the render.



the shape settings

Fast Editing

disables curve filling while in edit mode.

Fill

The fill options control how the text curves are filled in when text is Extruded or Beveled in the Geometry Panel.

Front

Fills in the front side of the surface.

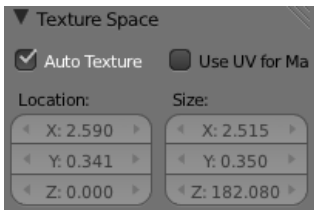
Back

Fills in the back side of the surface.

Fill Deformed

Fills the curves after applying shape keys and modifiers.

Textures



Texture Settings

Use UV for Mapping

Use UV values as generated texture coordinates.

Auto Texture Space

Adjusts the active objects texture space automatically when transforming object.

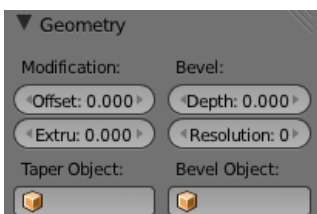
Bevel and Extrude

Text objects have all the [curves' extrusion features](#).

Modification

Offset

Sets the amount the curves are offset from their original positions. Creates a inflate/deflate effect.



the text geometry settings

Extrude

Extrudes the curved so they have thickness. You can adjust the thickness along the curves by using a Taper Object. See [Curve](#)

[Extruding](#)

Bevel

Beveling text causes it to have thickness, while the edges become beveled.

Depth

Sets the thickness of the text

Resolution

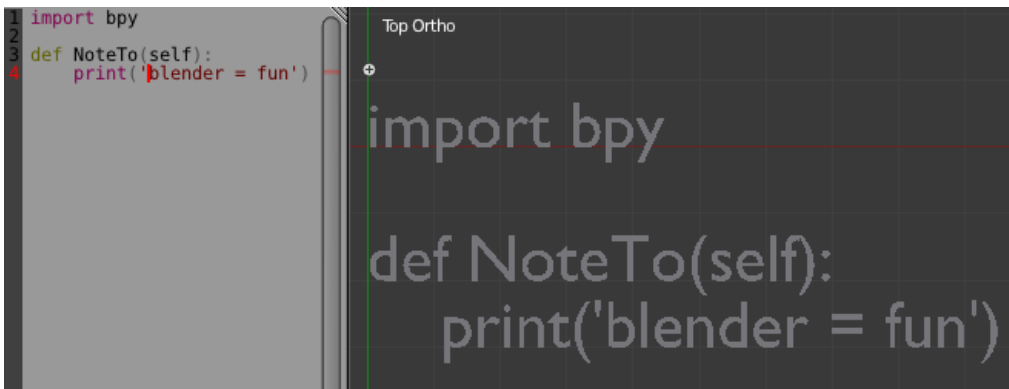
Sets how many divisions the bevel has. A value of 0 will give the bevel a flat profile. Increasing the value makes it more rounded and smoother. Using a curve for Bevel Object sets absolute values for the the Bevel depth and resolution.

Convert text to text object



An easy way to get text in blender is to type it in the text editor, and convert it to a text object.

to do this, load a text file in the text editor, or just type something. next convert it to a single text object, or to one text object per line. these options can be found under the Edit tab.



left normal text, right the made text object.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Modeling/Texts/Editing>"

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Meta Objects

Mode: Object or Edit modes

Hotkey: ⇧ ShiftA

Menu: Add » Meta

Meta objects are *implicit surfaces*, meaning that they are *not explicitly* defined by vertices (as meshes are) or control points (as surfaces are): they exist *procedurally*. Meta objects are literally mathematical formulas that are calculated on-the-fly by Blender.

A very distinct visual characteristic of metas is that they are fluid *mercurial*, or *clay-like* forms that have a “rounded” shape. Furthermore, when two meta objects get close to one another, they begin to interact with one another. They “blend” or “merge”, as water droplets do, especially in zero-g (which, by the way, makes them very handy for modeling streams of water when you don’t want to do a fluid simulation). If they subsequently move away from one another, they restore their original shape.

Each of these is defined by its own underlying [mathematical structure](#), and you can at any time switch between them using the Active Element panel.

Typically Meta objects are used for special effects or as a basis for modeling. For example, you could use a collection of metas to form the initial shape of your model and then convert it to another object type (well, only meshes are available...) for further modeling. Meta objects are also very efficient for ray-tracing.

Note that Meta objects have a slightly different behavior in Object mode, as detailed [below](#).

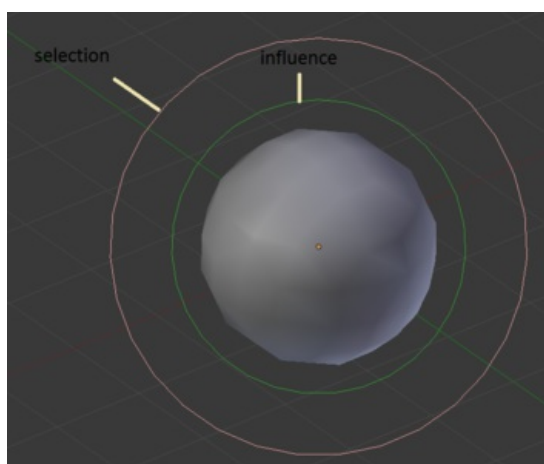
Primitives

There are five predefined meta “primitives” (or configurations) available in the Add » Meta sub-menu:

- Meta Ball adds a meta with a point underlying structure.
- Meta Tube adds a meta with a line segment underlying structure.
- Meta Plane adds a meta with a planar underlying structure.
- Meta Ellipsoid adds a meta with an ellipsoidal underlying structure.
- Meta Cube adds a meta with a volumetric cubic underlying structure.

Visualization

In Object mode, the calculated mesh is shown, along with a black “selection ring” (becoming pink when selected). To learn more on metas in Object mode, see [below](#).



Meta Ball example.

In Edit mode (*Meta Ball example*), a meta is drawn as a mesh (either shaded or as black wireframe, but without any vertex of course), with two colored circles: a red one for selection (pink when selected), and a green one for a direct control of the meta’s stiffness (see [below](#) – light green when active). Note that unless for the Scale (S) transformation, having the green circle highlighted is equivalent to having the red one.

Meta Ball Options

All Meta objects in a scene interact with each other. The settings in the MetaBall section apply to all meta objects. In Edit mode, the Active Element panel appears for editing individual meta elements.



global meta properties.

individual meta properties.

Resolution

The Resolution controls the resolution of the resultant mesh as generated by the Meta object.

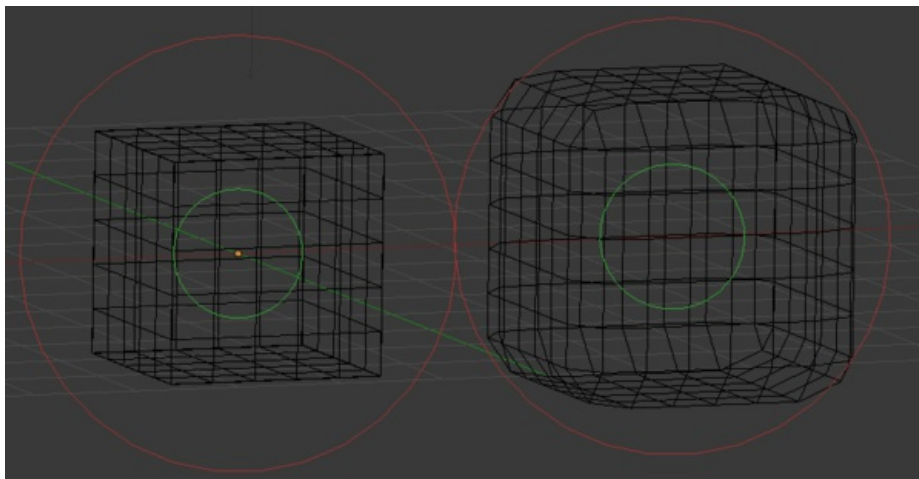
View

The 3D View resolution of the generated mesh. The range is from **0.05** (finest) to **1.0** (coarsest).

Render

The rendered resolution of the generated mesh. The range is from **0.05** (finest) to **1.0** (coarsest).

One way to see the underlying mathematical structure is to lower the Resolution, increase the Threshold and set the Stiffness (see below) a fraction above the Threshold. (*Underlying structure*) is a (*Meta cube*) with the above mentioned configuration applied as follows: Resolution of **0.410**, Threshold of **5.0** and Stiffness a fraction above at **5.01**.



Left: Underlying structure, Right: the shape.

You can clearly see the underlying cubic structure that gives the meta cube its shape.

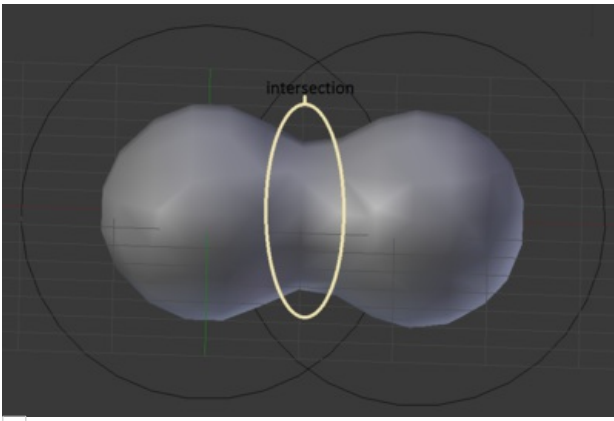
Threshold (Influence)

Mode: Object or Edit modes

Panel: MetaBall (Editing context, F9)

Threshold defines how much a meta's surface "influences" other metas. It controls the *field level* at which the surface is computed. The setting is global to a [group](#) of Meta objects. As the threshold increases, the influence that each meta has on one another increases.

There are two types of influence: **positive** or **negative**. The type can be toggled on the Active Element panel while in Edit mode, using the Negative button. You could think of **positive** as attraction and **negative** as repulsion of meshes. A negative meta will push away or repel the meshes of positive Meta objects.



Positive.

A *positive* influence is defined as an attraction meaning the meshes will stretch towards each other as the *rings of influence* intersect. (*Positive*) shows two meta balls' *ring of influence* intersecting with a *positive* influence.

Notice how the meshes have pulled towards one another. The area circled in white shows the green *influence* rings intersecting.

Update

While transforming metas (grab/move, scale, etc.), you have four “modes” of visualization, located in the Update buttons group of the MetaBall panel:

- Always – fully draw the meta during transformations.
- Half Res – During transformations, draw the meta at half its Wiresize resolution.
- Fast – Do not show meta mesh during transformations.
- Never – Never show meta mesh (not very recommended option, as the meta is only visible at render time!).

This should help you if you experiment difficulties (metas are quite compute-intensive...), but with modern computers, this shouldn't happen, unless you use many metas, or very high resolutions...

Meta Structure

Technical Details

A more formal definition of a meta object can be given as a *directing structure* which can be seen as the source of a static field. The field can be either positive or negative and hence the field generated by neighbouring directing structures can attract or repel.

The implicit surface is defined as the surface where the 3D field generated by all the directing structures assume a given value. For example a meta ball, whose directing structure is a point, generates an isotropic (i.e. identical in all directions) field around it and the surfaces at constant field value are spheres centered at the directing point.

Meta objects are nothing more than mathematical formulae that perform logical operations on one another (AND, OR), and that can be added and subtracted from each other. This method is also called **Constructive Solid Geometry** (CSG). Because of its mathematical nature, CSG uses little memory, but requires lots of processing power to compute.

Underlying Structure

Mode: Edit mode

Panel: MetaBall tools (Editing context, F9), Transform Properties

Blender has five types of metas, each determined by its underlying (or directing) structure. In Edit mode, you can change this structure, either using the relevant buttons in the MetaBall tools panel, or the drop-down list in the Transform Properties panel (N). Depending on the structure, you might have additional parameters, located in both Transform Properties and MetaBall tools panels.

Ball (point, zero-dimensional structure)

This is the simplest meta, without any additional setting. As it is just a point, it generates an isotropic field, yielding a spherical surface (this is why it is called Meta Ball or Ball in Blender).

Tube (straight line, uni-dimensional structure)

This is a meta which surface is generated by the field produced by a straight line of a given length. This gives a cylindrical surface, with rounded closed ends. It has one additional parameter:

- dx: The length of the line (and hence of the tube – defaults to **1.0**).

Plane (rectangular plane, bi-dimensional structure)

This is a meta which surface is generated by the field produced by a rectangular plane. This gives a parallelepipedal surface, with a fixed thickness, and rounded borders. It has two additional parameters:

- dx: The length of the rectangle (defaults to **1.0**).
- dy: The width of the rectangle (defaults to **1.0**).

Note that by default, the plane is a square.

Ellipsoid (ellipsoidal volume, tri-dimensional structure)

This is a meta which surface is generated by the field produced by an ellipsoidal volume. This gives an ellipsoidal surface. It has three additional parameters:

- dx: The length of the ellipsoid (defaults to **1.0**).
- dy: The width of the ellipsoid (defaults to **1.0**).
- dz: The height of the ellipsoid (defaults to **1.0**).

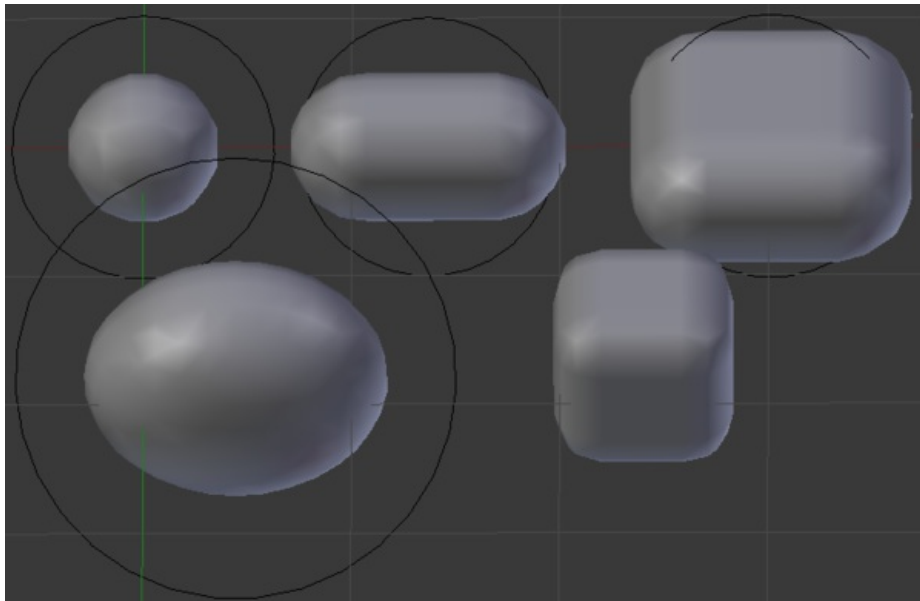
Note that by default, the volume is a sphere, producing a spherical meta, as the Ball option...

Cube (parallelepipedal volume, tri-dimensional structure)

This is a meta which surface is generated by the field produced by a parallelepipedal volume. This gives a parallelepipedal surface, with rounded edges. As you might have guessed, it has three additional parameters:

- dx: The length of the parallelepiped (defaults to **1.0**).
- dy: The width of the parallelepiped (defaults to **1.0**).
- dz: The height of the parallelepiped (defaults to **1.0**).

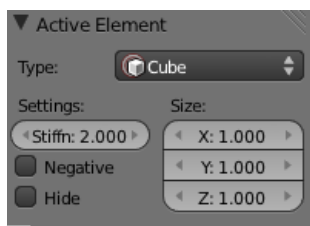
Note that by default, the volume is a cube.



☐ the 5 meta primitives.

Editing Metas

When in edit mode, the Active Element panel appears. These settings apply only to the selected meta element.



the active element panel.

Meta Shape


The Type menu lets you change the shape of the meta object, as explained above.

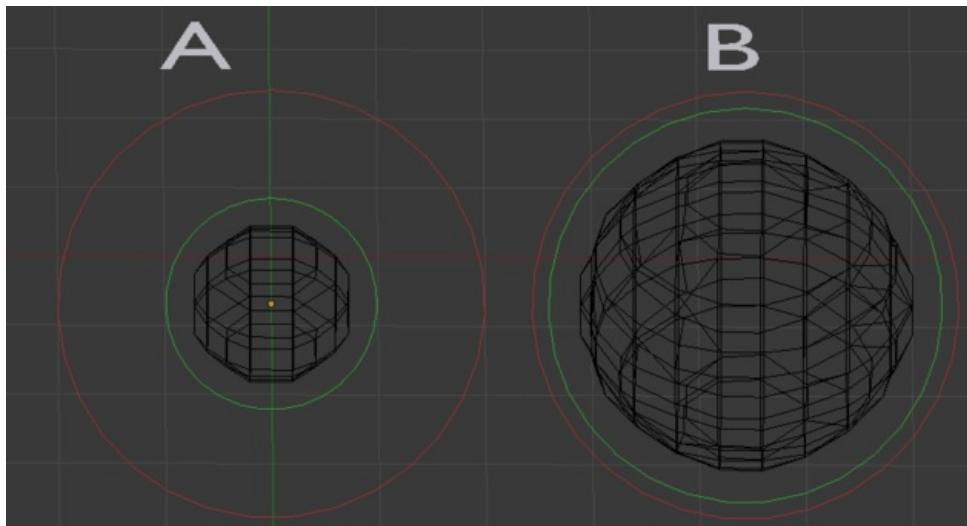
Stiffness

Together with Threshold, Stiffness controls the influencing range. While the threshold is common to all metas in a same object (or even a same [object family](#)), the stiffness is specific to each meta.

Scaling the inner green circle changes the Stiffness value. Stiffness defines how much the meta object is filled. This is essentially defines how sensitive a meta is to being affected by other metas. With a low stiffness, the meta will begin to deform from further away. A higher value means the meta needs to be close to another one to begin merging.

When a Meta object comes within “range” of another meta, the two will begin to interact with each other. They don’t necessarily need to intersect, and depending on the Threshold and Stiffness settings they most likely won’t need to. Stiffness is materialized by the *green ring*.

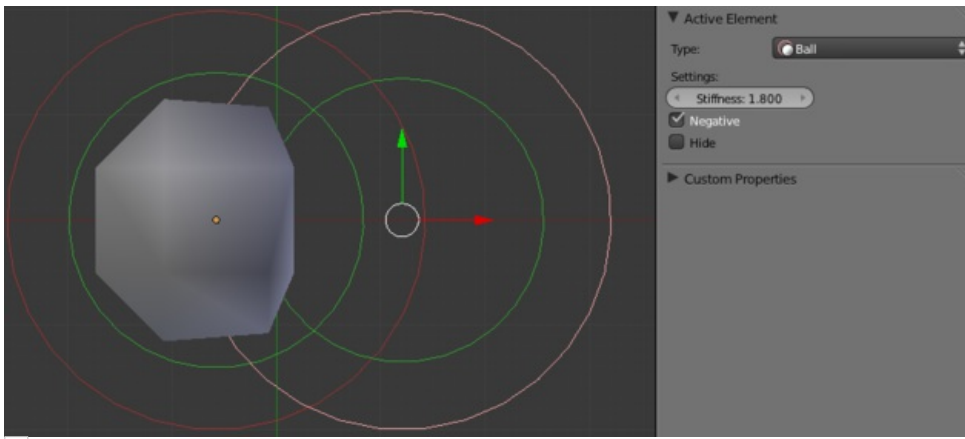
The range is from **0.0** to **10.0**. But to be visible the Stiffness must be slightly larger than the Threshold value. You can also visually adjust the Stiffness ring by using the RMB  to select it and activating Scale mode with the S.



Stiffness.

In (*Stiffness*), the meta ball labeled “A”, has a smaller Stiffness value than the one labeled “B”. As you can see the *green ring* radius is different between them.

Negative Influence



Negative.

The opposite effect of a *positive* influence would be a *negative* influence: the objects repel each other. (*Negative*) shows a meta ball and meta plane where the first is negative and the second, positive. Notice how the negative meta is not visible: only the surrounding circles appear. This is how Blender indicates that the object is negative.

Moving the sphere to the plane causes the plane's mesh to "cave in" or collapse inward. If you move the plane away from the sphere, the plane's mesh will restore itself.

To make a meta *negative*, just select the meta in edit mode, and check *negative* in the *active element* panel.

Hiding Elements

As in Object mode, you can hide the selected meta(s), and then reveal what was hidden. This is very handy to clean your views up a bit... Note that the two red and green rings always remain visible in Edit mode, as well as the select circle (in Object mode...).

To hide the current selection, use H, the Hide toggle button in the MetaBall tools, or the Metaball » Hide MetaElements » Hide Selected menu option.

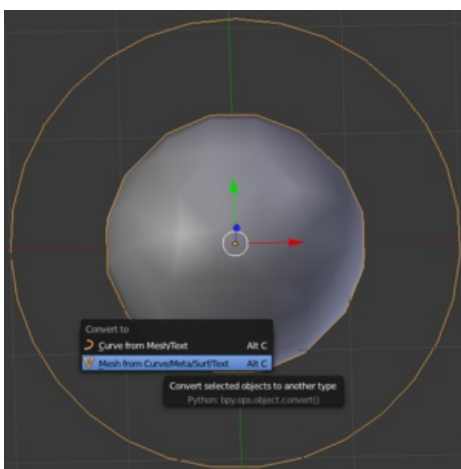
To hide everything but the current selection, hit ⇧ ShiftH or use Metaball » Hide MetaElements » Hide Deselected.

To reveal what was hidden, use AltH, or the relevant option in the same Metaball » Hide MetaElements menu. You can also un-toggle the Hide button (MetaBall tools panel).

Deleting Elements

There is no Erase menu for metas, just a confirmation pop-up asking you if you want to delete the selected metas. Clear and simple!

Conversion



the convert menu

You can only convert metas to meshes, but here you have the option to keep the original Meta object (i.e. create a new Mesh one, instead of a "real" conversion...). Note that the resolution used for the new mesh is the Wiresize one, not the Rendersize one.

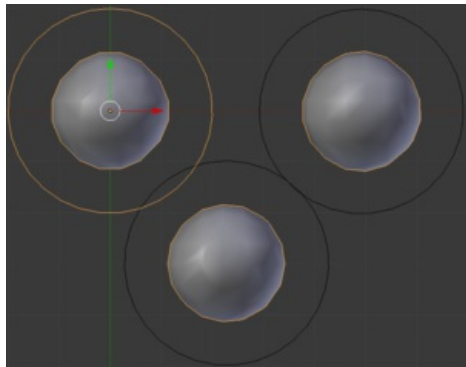
to convert the meta, press AltC in object mode, and select *mesh*

Object Families

Meta objects have a different behavior in Object mode than other object types – they can be “regrouped” in so-called “families”.

A “family” is a way to regroup several meta objects, producing something very similar to having several metas inside a same object.

A family is defined by the left part of an object’s name (the one before the dot). Remember object’s name is the one in the “OB” field, in most panels, **not** the “MB” field, which is the meta datablock’s name... For example, the *family* part of “MetaPlane.001” is “MetaPlane”. Each meta object in the same “family” is associated with one another as discussed below.



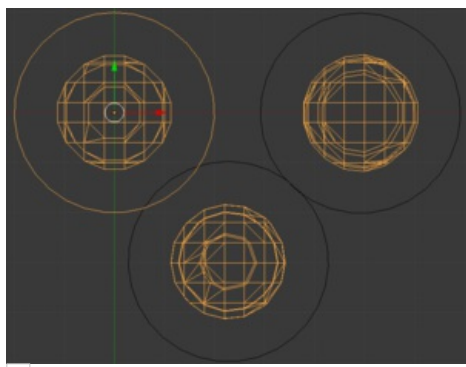
Meta ball base.

Families of metas are controlled by a *base* Meta object which is identified by an Object name **without** a right part. For example, if we have five metas called “MetaThing”, “MetaThing.001”, “MetaThing.002”, “MetaThing.003” and “MetaThing.004”, the *base* Meta object would be “MetaThing”.

The *base* Meta object determines the basis, the resolution, the threshold, *and* the transformations. It also has the material and texture area. The *base* meta is effectively the parent of (or perhaps a better word to use is “the owner of”) the other metas in the group (i.e. it is as if the other metas were “included” or joined into the base one).

Examples

(*Meta ball base*) shows the *base* meta labeled “B”. The other two Meta objects are *children*. Children’s selection rings are always black, while the group’s mesh is orange. Because the metas are grouped, they form a unified mesh which can always be selected by selecting the mesh of any meta in the group. For example, in the example (*Meta ball base*), only the lower sphere (the parent) has been selected, and you see that both the parent’s mesh *and* all of the children’s meshes are now highlighted.



Scaling the “base”.

The *base* Meta object controls the **polygonalization** (mesh structure) for the group, and as such, also controls the polygonalization for the children (*non-base*) metas. If we transform the *base* meta, the children’s polygonalization changes. However, if we transform the children, the polygonalization remains unchanged.

Hints

This discussion of “polygonization” *doesn’t* mean that the various meshes don’t deform towards or away from each other (meta objects always influence one another in the usual way, whether or not they are members of the same family). Rather, it means that the underlying mesh structure changes only when the *base* object transforms. For example, if you scale the *base*, the children’s mesh structure changes. In (*Scaling the “base”*), the *base* has been scaled down, which has the effect of scaling the mesh structure of each of the children. As you can see, the children’s mesh resolution has increased, while the *base* decreased. *The children did not change size!*

Page status ([reviewing guidelines](#))

Text

Needs a more detailed Uses + Functions section

Proposed fixes: none

Empties

The "Empty" is a null object. It contains no real Geometry, but can be used as a handle for many purposes.

Settings

Plain Axes

Draws as six line each pointing in +X,-X,+Y,-Y,+Z,and -Z axes.

Arrows

Draws as arrows pointing in the positive X,Y, and Z axes, each with a label.

Single Arrow

Draws as a single arrow pointing in the +Z axis.

Circle

Draws as a circle in the XZ plane.

Cube

Draws as a cube frame.

Sphere

Draws as an implied sphere defined by 3 circles.

Cone

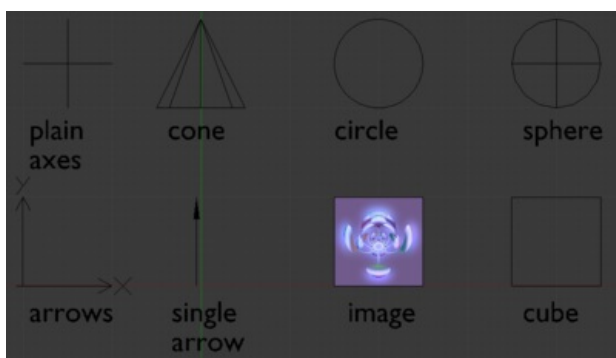
Draws as a cone, pointing in the +Y axis.

Image

Empties can now display images. This can be used to create reference images, including blueprints or character sheets to model from, instead of using background images. The image is displayed regardless of the 3d display mode. The settings are the same as in [Background Image Settings](#)

Size

Controls the local size of the empty. This does not change its scale, but simply resizes the shape.



The eight different empty draw types as seen from the top view

Usage and functions

They can serve as a transform handle, which cannot be edited and does not render. Empties are important and useful objects. Some examples of ways to use them include:

Parent object for a group of objects

- An Empty can be parented to any number of other objects - This gives the user the ability to control a group of objects easily, and without affecting a render.

Target for constraints

- An empty can also be used as a target for normal, or bone constraints.
- This gives the user far more control, for instance a rig can easily be setup to enable a camera to point towards an empty using the **Track to** constraint

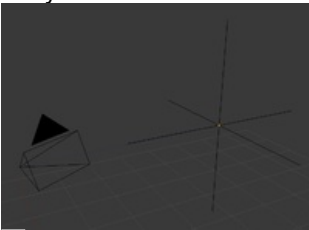
Array offset

- An empty can be used to offset an array modifier, meaning complex deformations can be achieved by only moving a single object



☐

An example of an empty being used to control an array



☐

An example of an empty being used to control the track to constraint

Other common uses.

- Placeholders
- Rigging controls
- DOF distances
- Reference Images

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Modeling/Groups>"

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Void page

Proposed fixes: none

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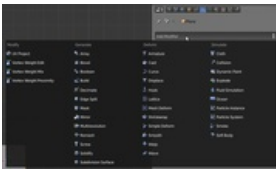
Partial page Text Missing some modifier

Proposed fixes: none

Modifiers

Mode: Any mode

Panel: Modifiers



Modifiers menu

Modifiers are automatic operations that affect an object in a non-destructive way. With modifiers, you can perform many effects automatically that would be otherwise tedious to do manually (such as subdivision surfaces) and without affecting the base topology of your object. Modifiers work by changing how an object is displayed and rendered, but not the actual object geometry. You can add several modifiers to a single object to form a [Modifier Stack](#) and you can Apply a modifier if you wish to make its changes permanent.

There are four types of modifiers:

Modify

The Modify group of modifiers are tools a bit similar to Transform ones, but which do not directly affect the shape of the object, rather some other data like vertex groups...

[UV Project](#)

Project UV coordinates on your mesh.

[Vertex Weight](#)

Edit a vertex group of your mesh, in various ways.

Generate

The Generate group of modifiers are constructive tools that either changes the general appearance of or automatically adds new geometry to an object.

[Array](#)

Create an array out of your basic mesh and similar (repeating) shapes.

[Bevel](#)

Create a bevel on a selected mesh object.

[Boolean](#)

Combine/subtract/intersect your mesh with another one.

[Build](#)

Assemble your mesh step by step when animating.

[Decimate](#)

Reduce the polygon count of your mesh.

[Edge Split](#)

Add sharp edges to your mesh.

[Mask](#)

Allows you to hide some parts of your mesh.

[Mirror](#)

Mirror an object about one of its own axis, so that the resultant mesh is symmetrical, and you only have to model/edit half, a fourth or a eighth of it.

[Multiresolution](#)

Sculpt your mesh at several levels of resolution.

[Screw](#)

Generate geometry in a helix-pattern from a simple profile. Similar to the Screw tool in the mesh editing context.

[Solidify](#)

Give a depth to mesh faces.

[Subdivision Surface](#)

Smooth the surface by creating interpolated geometry.

[Skin](#)

Automatically generated topology

Deform

The Deform group of modifiers only change the shape of an object, and are available for meshes, and often texts, curves, surfaces and/or lattices.

[Armature](#)

Use bones to deform and animate your object.

[Cast](#)

Shift the shape of a mesh, surface or lattice to a sphere, cylinder or cuboid.

[Curve](#)

Bend your object using a curve as guide.

[Displace](#)

Deform your object using a texture.

[Hook](#)

Add a hook to your vertice(s) (or control point(s)) to manipulate them from the outside.

[Lattice](#)

Use a Lattice object to deform your object.

[Mesh Deform](#)

Allows you to deform your object by modifying the shape of another mesh, used as a “Mesh Deform Cage” (like when using a lattice).

[Shrinkwrap](#)

Allows you to shrink/wrap your object to/around the surface of a target mesh object.

[Simple Deform](#)

Applies some advanced deformations to your object.

[Smooth](#)

Smooth the geometry of a mesh. Similar to the Smooth tool in the mesh editing context.

[Warp](#)

Warp a mesh by specifying two points the mesh stretches between.

[Wave](#)

Deform your object to form (animated) waves.

Simulate

The Simulate group of modifiers activate simulations. In most cases, these modifiers are automatically added to the modifiers stack whenever a Particle System or Physics simulation is enabled and their only role is to define the place in the modifiers stack used as base data by the tool they represent. Generally, the attributes of these modifiers are accessible in separate panels.

[Cloth](#)

Simulates the properties of a piece of cloth. It is inserted in the modifier stack when you designate a mesh as Cloth.

[Collision](#)

Simulate a collision between objects.

[Explode](#)

Blow up your mesh using a particle system.

[Fluid](#)

The object is part of a fluid simulation... Modifier added when you designate a mesh as Fluid.

[Particle Instance](#)

Make an object act similar to a particle but using the mesh shape instead.

[Particle System](#)

Represents a particle system in the stack, so it is inserted when you add a particle system to the object.

[Smoke](#)

Simulate realistic smoke.

[Soft Body](#)

The object is soft, elasticated... Modifier added when you designate a mesh as Softbody.

[Dynamic Paint](#)

Make an object or a particle system paint a material onto another object.

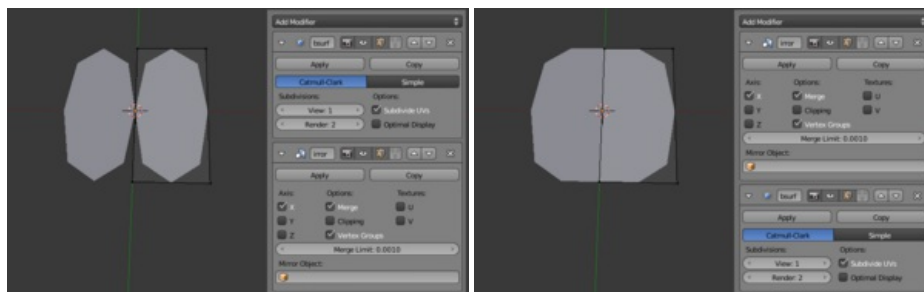
[Ocean](#)

Quickly create a realistic, animated ocean.

Modifier

A modifier is defined as the application of a “process” or “algorithm” upon objects. They can be applied interactively and non-destructively in just about any order the users chooses. This kind of functionality is often referred to as a “modifier stack” and is found in several other 3D applications.

Modifiers are added from the Modifiers menu. Some tools and scripts, for example Decimate and Solidify, have been migrated from its previous location and changed into a modifier. In a modifier stack the order in which modifiers are applied has an effect on the result. Fortunately modifiers can be rearranged easily by clicking the convenient up and down arrow icons. For example, (*Stack ordering*) shows [SubSurf](#) and [Mirror](#) modifiers that have switched places.

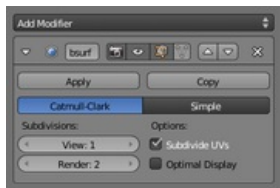


Stack ordering

In the first example, the Mirror modifier is the last item in the stack. The result looks like two surfaces. In the other example the mirror modifier is the first item in the stack and the result is a single merged surface.

You can see that the results look different from the previous. This means that the stack order is very important in defining the end results.

Interface



Panel Layout (Subsurf as an example)

Each modifier has been brought in from a different part of Blender, so each has its own unique settings and special considerations. However, each modifier's interface has the same basic components, see (*Panel Layout (Subsurf as an example)*).

At the top is the panel header. The icons each represent different settings for the modifier (left to right):

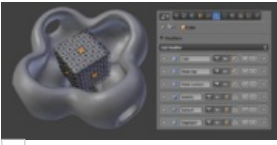
1. Arrow — Collapse modifier to show only the header.
2. Modifier icon and a box for the name of this modifier — default being the name of the modifier itself. It is unique amongst other modifiers of the same type.
3. Camera — Display modifier effect during render time.
4. Eye — Display modifier effect in the 3D view.
5. Box — Shows modifier effect in Edit mode. This button may not be available depending on the type of modifier.
6. Triangle — Applies modifier to editing cage in Edit mode. This icon materializes the Cage mode.
7. Up arrow — Moves modifier up in the stack.
8. Down arrow — Moves modifier down in the stack.
9. Cross — Removes the modifier from the stack.

Below the header are two buttons:

1. Apply – Makes the modifier real.
2. Copy – Creates a copy of the modifier at the base of the stack.

And below these buttons is a sub panel with settings for individual modifiers.

Stack



In this example a simple subdivided cube has been transformed into a rather complex object using a stack of modifiers.

([.blend](#))

To add a modifier you add it to the *stack*. Once added (always at the bottom of the stack), they can be rearranged to your liking.

Some modifiers can only be applied to certain object types. This is indicated by the panel filtering the Add Modifier button on the Modifiers panel. Only modifiers that can be applied are shown in this listbox button. Mesh objects can have all available modifiers added, while, for example, Lattice objects type objects can only have a few.

UV Project Modifier

Mode: Any mode

Panel: Modifiers (Generate)

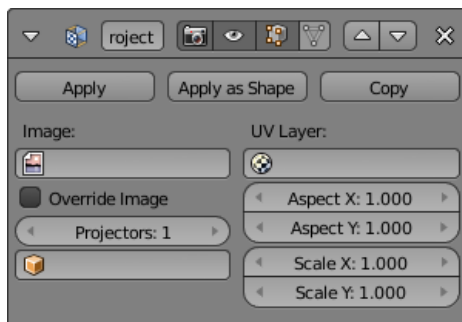


Projecting the Blender logo onto Suzanne.

UV Project acts like a slide projector. It emits a UV map from the -Z axis of up to ten objects, and applies it to the object as the "light" hits it. It can optionally override the object's [face texture](#).

[Download an example](#)

Options



UV layer

Which [UV layer](#) to modify. Defaults to the active rendering layer.

Image

The [image](#) associated with this modifier. Not required; you can just project a UV for use elsewhere. *Override Image*, below, defines how the image is used.

Override Image

- When true, the [Face Texture](#) of all vertices on the mesh is replaced with the Image. This will cause the image to repeat, which is usually undesirable.
- When false, the modifier is limited to faces with the Image as their Face Texture.

Projectors

<Objects>

Up to ten projector objects are supported. Each face will choose the projector that is aligns closest with its [surface normal](#).

Projections emit from the -Z axis (i.e. straight down a camera or lamp).

If the projector is a camera, the projection will adhere to its perspective/orthographic setting.

Aspect X/Y

Scale X/Y

These allow simple manipulation of the image.

Usage

UV Project is great for making spotlights more diverse, and also for creating [decals](#) to break up repetition.

The modifier's Image property is not generally used: instead, a [Texture](#) mapped to the [UV layer](#) that the modifier targets is added to the object's [Material](#). This allows you to prevent the image from repeating by setting *Texture > Image Mapping > Extension* to *Clip*.

WeightVGroup Modifiers

Mode: Any mode

Panel: Modifiers (Modifiers properties)

Description

The WeightVGroup modifiers work on a vertex group of the affected object, by modifying its weights and/or which vertices belong to this group.

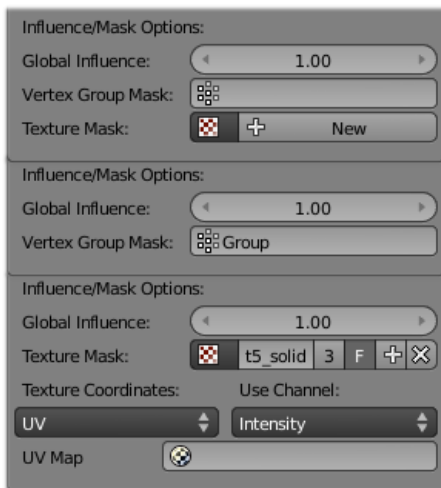


Those modifiers do implicit clamping of weight values in the standard $[0.0, 1.0]$ range. So all values below **0.0**/above **1.0** will be lost!

There are currently three WeightVGroup modifiers:

- [Vertex Weight Edit](#).
- [Vertex Weight Mix](#).
- [Vertex Weight Proximity](#).

Common Settings



The influence/masking part of WeightVGroup modifiers.

The three WeightVGroup modifiers share a few settings, controlling their influence on the affected vertex group.

Global Influence

The overall influence of the modifier (**0.0** will let the vertex group's weights untouched, **1.0** is standard influence).



Note that influence only affects weights, adding/removing of vertices to/from vertex group is not prevented by setting this value to **0.0**!

Vertex Group Mask

An additional vertex group, which weights will be pre-multiplied with the global influence value, for each vertex. If a vertex is not in the masking vertex group, it's masking weight (and hence its influence) will be null.

Texture

An additional texture, which values will be pre-multiplied with the global influence value, for each vertex. You can choose which channel of the texture to use as values.

This is a standard texture ID control. When set, it reveals other settings:

Texture Coordinates

How the texture is mapped to the mesh... You have four choices:

- Local: use local vertices coordinates.
- Global: use the vertices coordinates in the global space.
- Object: use the vertices coordinates in another object's space.
- UV: use an UV layer's coordinates.

Use Channel

Which channel to use as weight factor source (intensity, RGB, HSV, alpha – the options are quite self-explanatory, I guess...).

Object

The object to be used as reference for Object mapping...

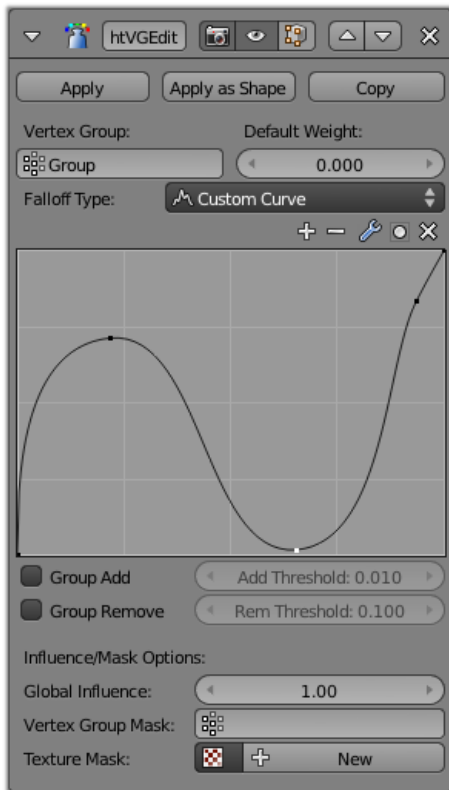
UV Layer

The UV layer to be used for UV mapping...

Viewing Modified Weights

You will now view the modified weights in WeightPaint mode. This also implies that you'll have to disable the Vertex Weight modifiers if you want to see the original weights of the vertex group you are editing (provided it is affected by some modifier, obviously).

Vertex Weight Edit Modifier



The WeightVGEdit modifier panel.

This modifier is intended to edit the weights of one vertex group.

The general process is the following, for each vertex:

1. [Optional] It does the mapping, either thru one of the predefined functions, or a custom mapping curve.
2. It applies the influence factor, and optionally the vertex group or texture mask (null values mean original weight, **1.0** ones mean fully mapped weight).
3. It applies back the weight to the vertex, and/or it might optionally remove the vertex from the group if its weight is below a given threshold, or add it if it's above a given threshold.

Options

Vertex Group

The vertex group to affect.

Default Weight

The default weight to assign to all vertices not in the given vertex group.

Falloff Type

Type of mapping:

- Linear – No mapping.
- Custom Curve – Enables the the curve mapping. This shows up a curve control.
- Sharp, Smooth, Root and Sphere are classical mapping functions, from spikiest to roundest.
- Random – Fully randomizes the weights!

- Median Step – Creates binary weights (**0.0** or **1.0**), with **0.5** as cutting value.

Group Add

Adds vertices with a final weight over Add Threshold to the vertex group.

Group Remove

Removes vertices with a final weight below Rem Threshold from the vertex group.

Vertex Weight Mix Modifier



The WeightVGMix modifier panel.

This modifier mixes a second vertex group (or a simple value) into the affected vertex group, using different operations.

It also has an option to choose which vertices to work on (all, only those of the first or second vertex group, etc.).



This implies that it *might* add vertices to the affected vertex group (it will never remove vertices, though), see below for details.

Options

Vertex Group A

The vertex group to affect.

Default Weight A

The default weight to assign to all vertices not in the given vertex group.

Vertex Group B

The second vertex group to mix in affected one. Leave it empty if you only want to mix in a simple value.

Default Weight B

The default weight to assign to all vertices not in the given second vertex group.

Mix Mode

How the vertex group weights are affected by the other vertex group's weights. You have seven choices:

- Replace weights just replaces affected weights by the second weights.
- Add to weights adds both values.
- Subtract from weights subtracts the second weights from the affected weights.
- Multiply weights multiplies both weights.
- Divide weights divides the affected weights by the second weights.
- Difference computes the difference between affected weights and second weights (it's just the absolute value of the subtract operation).
- Average computes the average value of both weights.

Mix Set

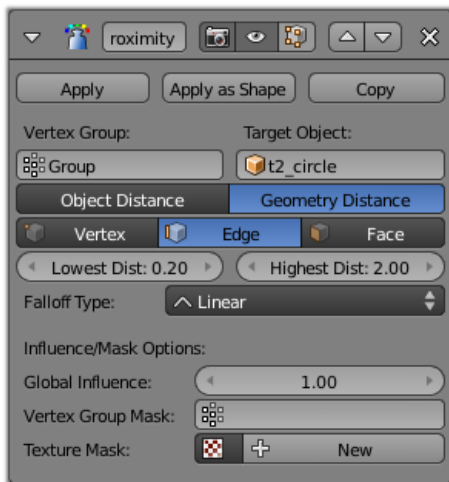
Which vertices to work on. You have five options:

- All vertices affects all vertices, disregarding the vertex groups content. *This option might add vertices to the affected vertex group.*
- Vertices from group A affects only vertices belonging to the affected vertex group.
- Vertices from group B affects only vertices belonging to the second vertex group. *This option might add vertices to the affected vertex group.*
- Vertices from one group affects only vertices belonging to at least one of the vertex groups. *This option might add*

vertices to the affected vertex group.

- Vertices from both groups affects only vertices belonging to both vertex groups.

Vertex Weight Proximity Modifier



The WeightVGProximity modifier panel.

This modifier sets the weights of the given vertex group, based on the distance between the object (or its vertices), and another target object (or its geometry).

Options

Vertex Group

The vertex group to affect.

Target Object

The object from which to compute distances.

Proximity mode

- Object Distance will use the distance between the modified mesh object and the target object as weight for all vertices in the affected vertex group.
- Geometry Distance will use the distance between each vertex and the target object, or its geometry.

The Geometry Distance mode has three additional options, to use the target object's geometry instead of its center location (if you enable more than one of them, the shortest computed distance will be used). If the target object has no geometry (e.g. an empty or camera one), it will silently fall back to the default Object Distance behavior.

Vertex

This will set each vertex's weight from its distance to the nearest vertex of the target object.

Edge

This will set each vertex's weight from its distance to the nearest edge of the target object.

Face

This will set each vertex's weight from its distance to the nearest face of the target object.

Lowest Dist

Distance mapping to **0.0** weight. It can be above Highest Dist for reversed mapping effects.

Highest Dist

Distance mapping to **1.0** weight. It can be below Lowest Dist for reversed mapping effects.

Falloff Type

Some predefined mapping functions, see [the Vertex Weight Edit part above](#).

Examples

Using Distance from a Target Object

As a first example, let's dynamically control a Wave modifier with a modified vertex group.

Add a Grid mesh, with enough vertices (e.g. a **100×100** vertices one), and **10** BU side-length. Switch to Edit mode (⇐ Tab), and in the Object Data properties, Vertex Groups panel, add a vertex group. Assign to it all your mesh's vertices (with e.g. a **1.0** weight). Go

back to Object mode.

Then, go to the Modifiers properties, and add a Vertex Weight Proximity modifier. Set the mode to Object Distance. Select your vertex group, and the target object you want (here I used the lamp).

You will likely have to adjust the linear mapping of the weights produced by the Vertex Weight Proximity modifier. To do so, edit Lowest Dist and Highest Dist so that the first corresponds to the distance between your target object and the vertices you want to have lowest weight, and similarly with the second and highest weight...

Now add a Wave modifier, set it to your liking, and use the same vertex group to control it.

Animate your target object, making it move over the grid. As you can see, the waves are only visible around the reference object! Note that you can insert a Vertex Weight Edit modifier before the Wave one, and use its Custom Curve mapping to get larger/narrower “wave influence’s slopes”.

[The Blender file](#), TEST_1 scene.

Using Distance from a Target Object's Geometry

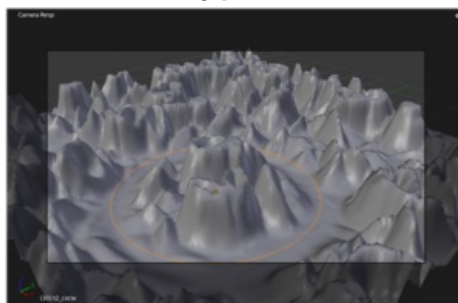
We're going to illustrate this with a Displace modifier.

Add a **10×10 BU 100×100** vertices grid, and in Edit mode, add to it a vertex group containing all of its vertices, as above. You can even further sub-divide it with a first Subsurf modifier.

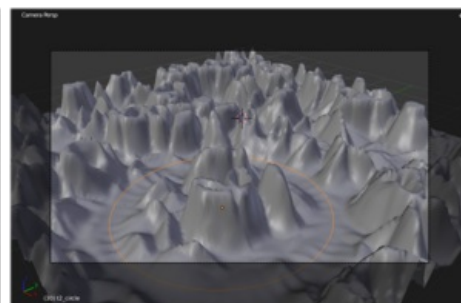
Now add a curve circle, and place it **0.25 BU** above the grid. Scale it up a bit (e.g. **4.0**).

Back to the grid object, add to it a Vertex Weight Proximity modifier, in Geometry Distance mode. Enable Edge (if you use Vertex only, and your curve has a low U definition, you would get wavy patterns, see (*Wavy patterns*)).

Wavy patterns.



Distance from edges.



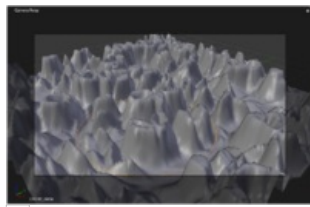
Distance from vertices.

Set the Lowest Dist to **0.2**, and the Highest Dist to **2.0**, to map back the computed distances into the regular weight range.

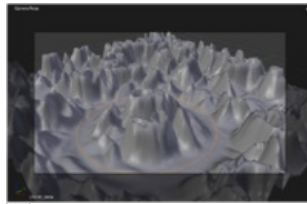
Add a third Displace modifier and affect it the texture you like. Now, we want the vertices of the grid nearest to the curve circle to remain undisplaced. As they will get weights near zero, this means that you have to set the Midlevel of the displace to **0.0**. Make it use our affected vertex group, and that's it! Your nice mountains just shrink to a flat plane near the curve circle.

As in previous example, you can insert a Vertex Weight Edit modifier before the Displace one, and play with the Custom Curve mapping to get a larger/narrower “valley”...

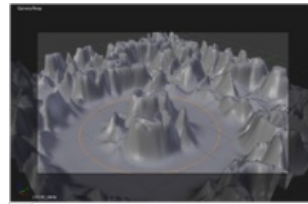
Curve Map variations.



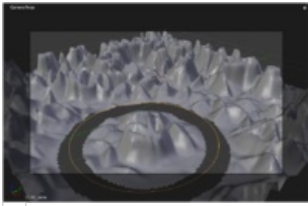
Concave-type mapping curve.



No mapping curve (linear).



Convex-type mapping curve.



Vertices with a computed weight below **0.1** removed from the vertex group.

You can also add a fifth Mask modifier, and enable Vertex Weight Edit's Group Remove option, with a Rem Threshold of **0.1**, to see the bottom of your valley disappear.

[The Blender file](#), TEST_2 scene.

Using a Texture and the Mapping Curve

Here we are going to create a sort of strange alien wave (yes, another example with the Wave modifier... but it's a highly visual one, it's easy to see the vertex group effects on it...).

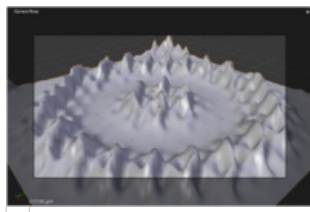
So as above, add a **100×100** grid. This time, add a vertex group, but without assigning any vertex to it – we'll do this dynamically.

Add a first Vertex Weight Mix modifier, set the Vertex Group A field with a Default Weight A of **0.0**, and set Default Weight B to **1.0**. Leave the Mix Mode to Replace weights, and select All vertices as Mix Set. This way, all vertices are affected. As none is in affected vertex group, they all have a default weight of **0.0**, which is replaced by the second default weight (**1.0**). And all those vertices are also added to the affected vertex group.

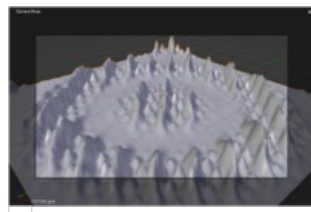
Now, select or create a masking texture – here I chose a default Magic one. The values of this texture will control how much of the “second weight” (**1.0**) replaces the “first weight” (**0.0**)... In other words, they are taken as weight values!

You can then select which texture coordinates and channel to use. Leave the mapping to the default Local option, and play with the various channels...

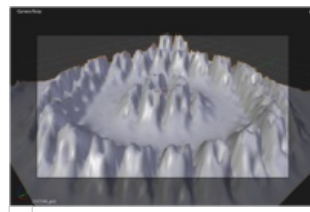
Texture channel variations.



Using intensity.



Using Red.



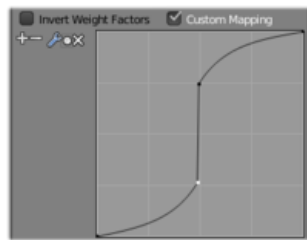
Using Saturation.

Don't forget to add a Wave modifier, and select your vertex group in it!

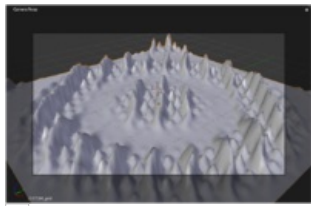
You can use the weights created this way directly, but if you want to play with the curve mapping, you must add the famous Vertex Weight Edit modifier, and enable its Custom Curve mapping.

By default, it's a one-to-one linear mapping – in other words, it does nothing ! Change it to something like in (*A customized mapping curve*), which maps $[0.0, 0.5]$ to $[0.0, 0.25]$ and $[0.5, 1.0]$ to $[0.75, 1.0]$, thus producing nearly only weights below **0.25**, and above **0.75**: this creates great "walls" in the waves...

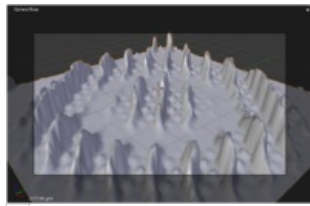
Custom mapping curve.



A customized mapping curve.



Custom Mapping disabled.



Custom Mapping enabled.

[The Blender file](#), TEST_4 scene.

See Also

- The [Development page](#).

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Modifiers/Modify/Vertex_Weight"


Doc:2.6/Manual

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Array Modifier

Mode: Object mode

Panel: Properties Window -> Context Button Modifiers 

Description



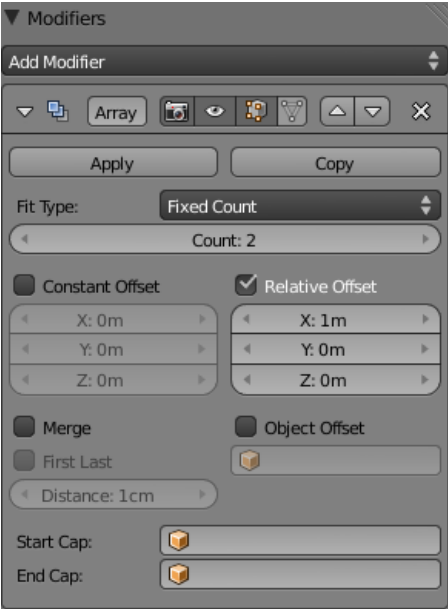
Multidimensional array animated with motion blur.

The Array modifier creates an array of copies of the base object, with each copy being offset from the previous one in a number of possible ways. Vertices in adjacent copies can be merged based on a merge distance, allowing smooth subsurf frameworks to be generated.

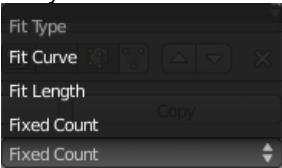
This modifier can be useful when combined with tilable meshes for quickly developing large scenes. It is also useful for creating complex repetitive shapes.

Multiple array modifiers may be active for an object at the same time e.g. to create complex 3 dimensional constructs.

Options



Array modifier.



Fit Type menu.

Fit Type menu

Controls how the length of the array is determined. There are three choices, activating respectively the display of the Curve, Length or Count setting:

- Fit Curve – Generates enough copies to fit within the length of the curve object specified in Curve.
- Fit Length – Generates enough copies to fit within the fixed length given by Length.
- Fixed Count – Generates the number of copies specified in Count.

Curve

The Curve object to use for Fit Curve.

Length

The length to use for Fit Length.

Count

The number of duplicates to use for Fixed Count.

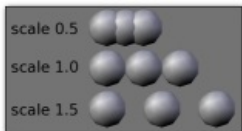
Notes

- Both Fit Curve and Fit Length use the local coordinate system size of the base object, which means that scaling the base object in Object mode will not change the number of copies generated by the Array modifier. Applying the scale (Apply Scale) can be useful in this case.
- Fit Length uses the local coordinate system length of the curve, which means that scaling the curve in Object mode will not change the number of copies generated by the Array modifier. Applying the scale (Apply Scale) can also be useful in this case.

Constant Offset, X, Y, Z

Adds a constant translation component to the duplicate object's offset. X, Y and Z constant components can be specified.

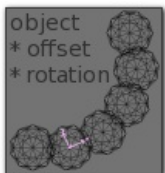
Relative Offset, X, Y, Z



Relative offset example.

Adds a translation equal to the object's bounding box size along each axis, multiplied by a scaling factor, to the offset. X, Y and Z scaling factors can be specified. See (*Relative offset example*).

Object Offset



Object offset example.

Adds a transformation taken from an object (relative to the current object) to the offset. See (*Object offset example*). It is a good practice to use an Empty object centered or near to the initial object. E.g. by rotating this Empty a circle or helix of objects can be created.

Merge

If enabled, vertices in each copy will be merged with vertices in the next copy that are within the given distance.

First Last

If enabled **and** Merge is enabled, vertices in the first copy will be merged with vertices in the last copy (this is useful for circular objects, see (*First Last merge example*)).



Subsurf discontinuity caused by not merging vertices between first and last copies (First Last off).

First Last merge example.



Subsurf discontinuity eliminated by merging vertices between first and last copies (First Last on).

Distance

Controls the merge distance for Merge.

Start cap

The mesh object to be used as a start cap. A single copy of this object will be placed at the “beginning” of the array – in fact, as if it was in position **-1**, i.e. one “array step” before the first “regular” array copy. Of course, if Merge is activated, and the Start cap is near enough of the first copy, they will be merged.

End cap

The mesh object to be used as an end cap. A single copy of this object will be placed at the “end” of the array – in fact, as if it was in position **n+1**, i.e. one “array step” after the last “regular” array copy. And as Start cap, it can be merged with the last copy...

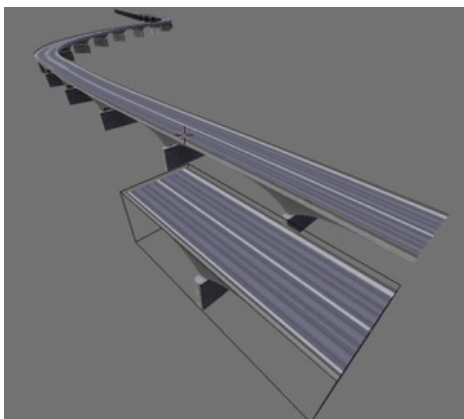
Hints

Offset Calculation

The transformation applied from one copy to the next is calculated as the sum of the three different components (Relative, Constant and Object), all of which can be enabled/disabled independently of the others. This allows, for example, a relative offset of **(1, 0, 0)** and a constant offset of **(0.1, 0, 0)**, giving an array of objects neatly spaced along the X axis with a constant **0.1BU** (Blender Units) between them, whatever being the original object's size.

Examples

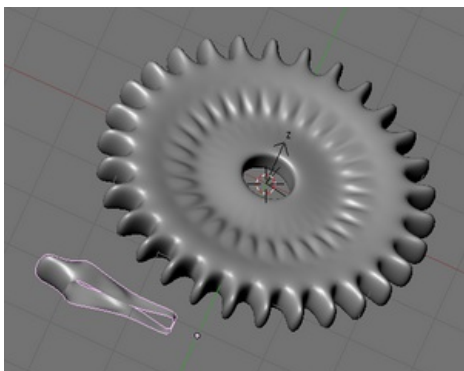
Mechanical



A bridge made from a tilable mesh.

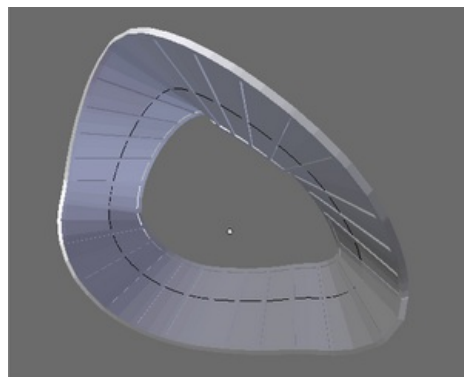
Note

As the Curve modifier could not be after Array in the modifier stack (at the time this image was created), the Array modifier was applied (i.e. the Apply button was pressed) before the curve was added in the bridge image.



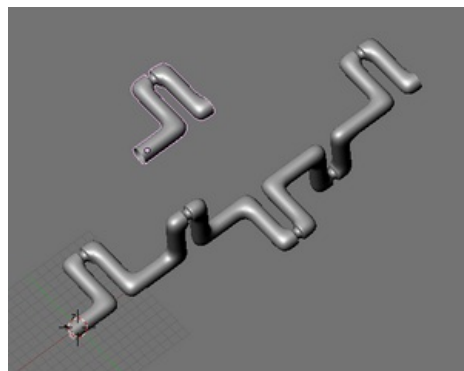
A cog created from a single segment.

[Sample blend file](#)



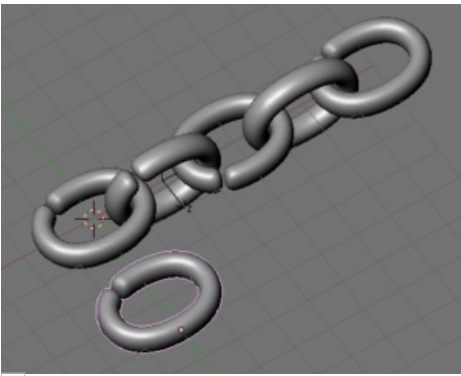
A track.

[Sample blend file](#)



A crankshaft.

[Sample blend file](#)

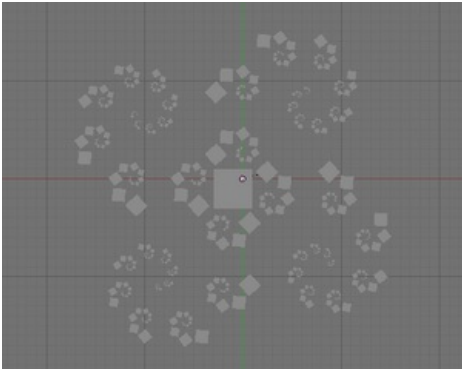


A chain created from a single link.
[Sample blend file](#)

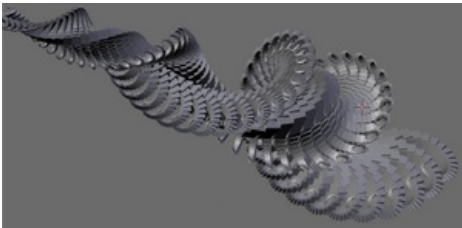
Fractal



Multidimensional array animated with motion blur.



A fractal-like image created with multiple array modifiers applied to a cube.
[Sample blend file](#)

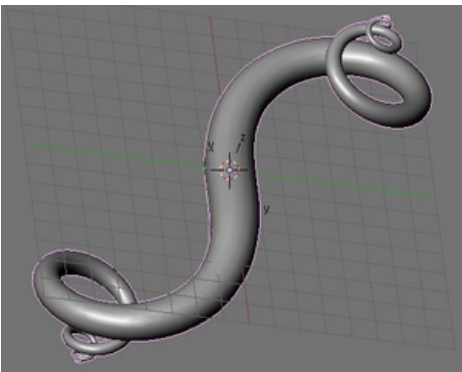


A fractal fern image created with 2 array modifiers and 1 mirror applied to a cube.

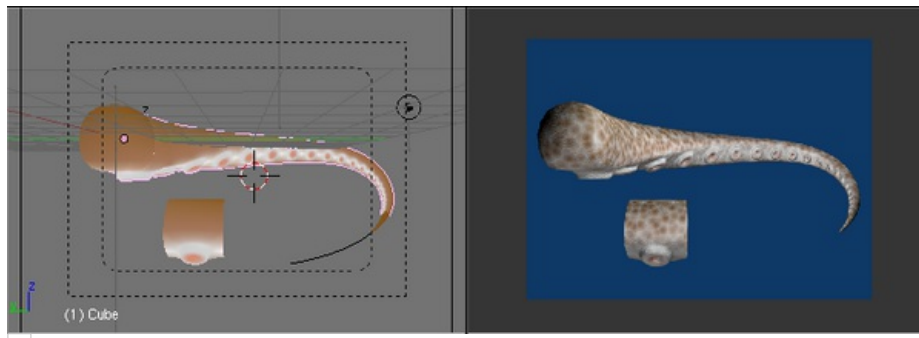
Organic



Subsurf cube array with 1 object offset, 4 cubes and a high vertex merge setting to give the effect of skinning.



A double spiral created with two array modifiers and one subsurf modifier applied to a cube. As above, the vertex merge threshold is set very high to give the effect of skinning.
[Sample blend file](#)



A tentacle created with an Array modifier followed by a Curve modifier. The segment in the foreground is the base mesh for the tentacle; the tentacle is capped by two specially modeled objects deformed by the same Curve object as the main part of the tentacle.

[Sample blend file](#)

Tutorials

Tutorials

- [Neal Hirsig's Array Modifier Screencast](#)
- [Creating A Double Helix With Modifiers](#)

The 'Double Helix' tutorial explains the Array modifier. It is for an old Blender Version (2.44) but except for the keyboard shortcuts it is still valid.


Page status ([reviewing guidelines](#))

Partial page Text Weight is working but need instruction (see in Discussion for workflow)

Proposed fixes: none

Bevel Modifier

Mode: Object mode

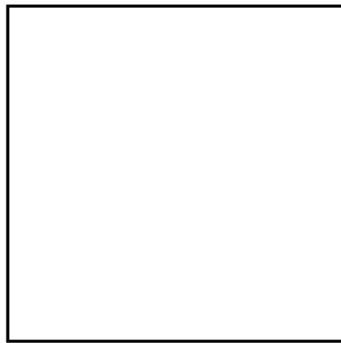
Panel: Properties Window -> Context Button Modifiers 

Description

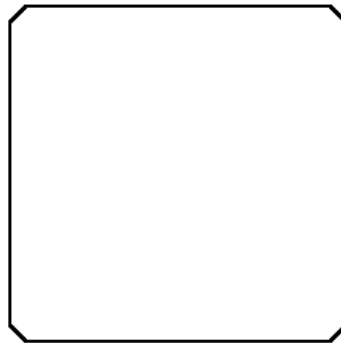
The Bevel modifier adds the ability to bevel the edges of the mesh it is applied to, allowing control of how and where the bevel is applied to the mesh.

What is a *Bevel* ?

Wikipedia definition of [bevel](#).

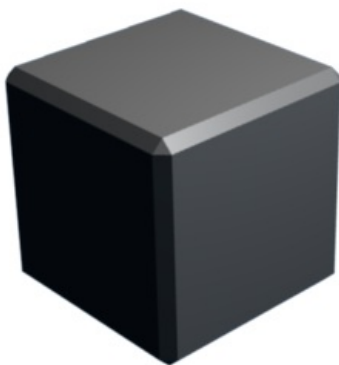


Unbeveled square.



Beveled square.

The picture (*Unbeveled square*) shows a square which has unbeveled edges as the angles between the corners of the square are 90° (perpendicular). The picture (*Beveled square*) shows a square which has beveled corners.

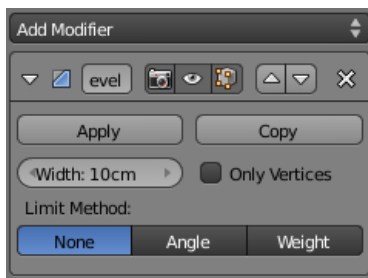


Default bevel.

Although the two pictures above show 2D squares, the Blender Bevel modifier can work on both 2D and 3D meshes of almost any shape, not just squares and cubes...

The picture (*Default bevel*) shows a Blender 3D cube with a bevel applied using just the default Bevel modifier settings.

Options



Bevel modifier panel.

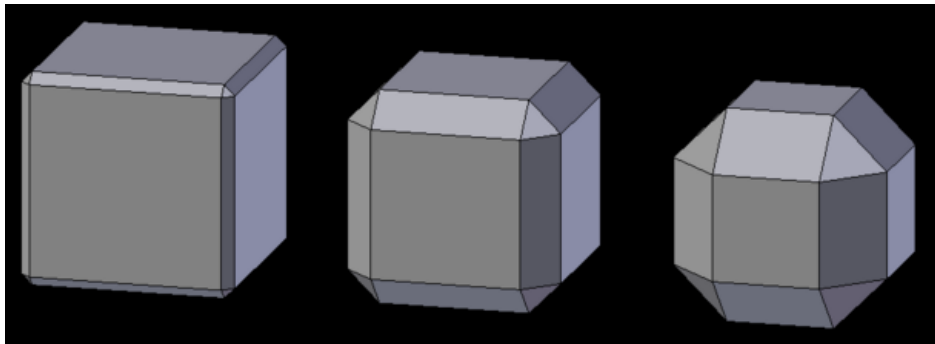
The Bevel modifier panel is a reasonably uncluttered panel and, for the most part, intuitive. That said, here is a description the settings contained within this panel:

Width

The Width numeric field controls the width/amount of the bevel applied to the base mesh. It can range from **0.0** (no bevel applied) to **1.0** (Blender Units). This value is in fact the “backing up” of the two new edges relatively to the original (beveled) one, along the two concerned faces.

Note

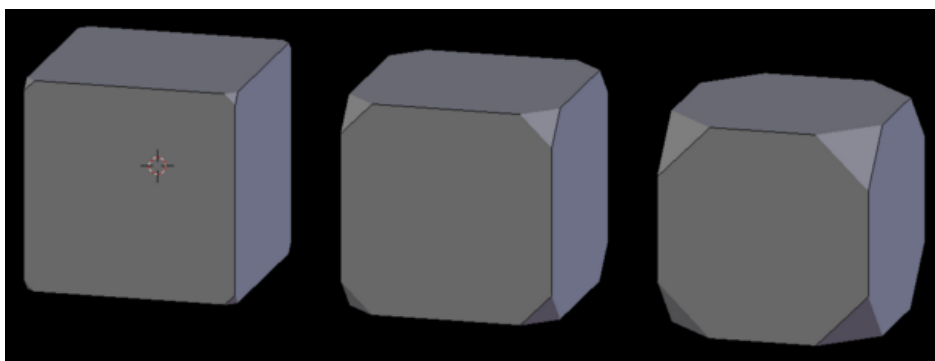
When using Metric or Imperial units the Width value has a unit. E.g. when 1 Blenderunit is 1m a useful value is between 0cm and 100cm. When it seems that decreasing the Width has no effect anymore check if the unit changed to m instead of cm.



Three Cubes with **0.1**, **0.3** and **0.5** bevel Widths.

Only Vertices

The Only Vertices button alters the way in which a bevel is applied to the mesh. When it is active, only the areas near vertices are beveled, the edges are left unbeveled.



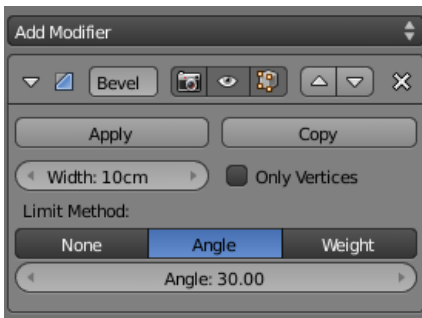
Three cubes with **0.1**, **0.3** and **0.5** bevel Widths, with Only Vertices option enabled.

Limit Method

This section of the Bevel modifier is used to control where and when a bevel is applied to the underlying mesh. The first row of three buttons (mutually exclusive) controls the algorithm used, and might add some extra options.

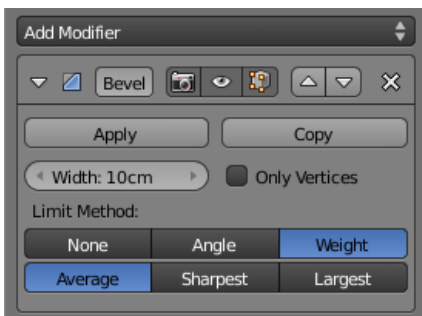
None

This button will apply the Bevel modifier to the whole underlying mesh, without any way to prevent the bevel on some edges/vertices.



Bevel modifier with the Angle limit enabled.

Angle
 This button will only bevel edges where faces make sharp angles. When selected, it displays the Angle numeric field, used to set the angle above which an edge will be beveled (it is in fact the complementary angle, i.e. $180^\circ - (\text{angle between faces})$). When the angle between meeting faces is less than the angle in the slider box, the bevel on those specific edges will not be applied. Similarly, when the angle between two edges is less than this limit, the vertex is not beveled.



Bevel modifier with Weight button active.

Weight
 TODO...

External tutorials

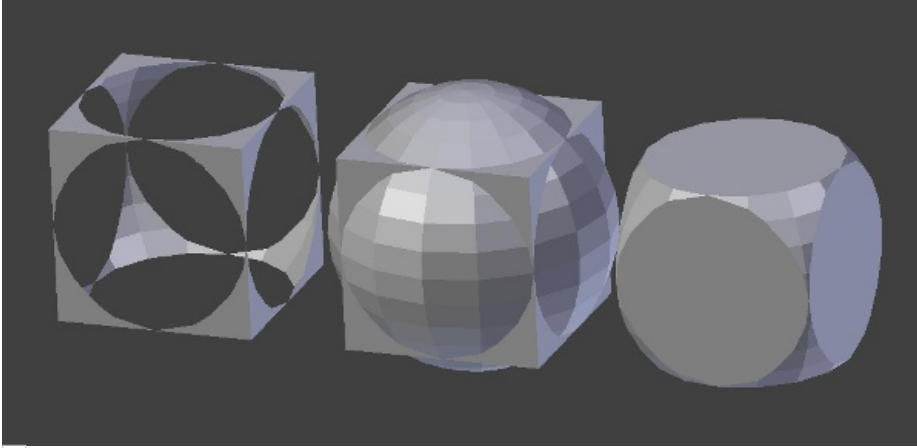
- [Neal Hirsig's Bevel Modifier Screencast](#) broken link!

Boolean Modifier

Mode: Any mode

Panel: Modifiers

Description



The Difference, Union, and Intersection between a Cube and a UV Sphere, with the modifier applied to the Cube

The Boolean modifier uses one of three Boolean operations (Difference (negation), Union (disjunction), and Intersect (conjunction)) to create a single compound object out of two Mesh objects.

Options



Boolean modifier

Operation

Difference

The target mesh is subtracted from the modified mesh.

Union

The target mesh is added to the modified mesh.

Intersect

The target mesh is subtracted from the modified mesh.

Object

The name of the target object. Must be a mesh.

See also

- [Doc:Manual/Modifiers/Mesh/Booleans](#) (documentation for the Blender 2.4 Boolean mesh editing tool including several examples)

Page status ([reviewing guidelines](#))

Partial page Text need img of the effect (animated gif?)

Proposed fixes: [X](#)

done

Build Modifier

Mode: Object mode

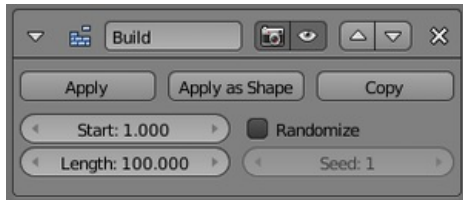
Panel: Modifiers

Description

The Build modifier causes the faces of the mesh object to appear, one after the other, over time. If the material of the mesh is a halo rather than a standard one, then the vertices of the mesh, not the faces, appear one after another.

By default, faces (or vertices) appear in the order in which they are stored in memory (by default, they order of creation). These orders can be altered in Edit mode using Sort Faces (CtrlAltF).

Options



Build modifier

Start

The start frame of the building process.

Length

The number of frames over which to build up.

Randomize

Randomizes the order that the faces are built up.

Seed

The random seed. Change this to get a different “random” order of appearing – this order being always the same for a given (seed, object) set.

Decimate Modifier

Mode: Object mode

Panel: Modifiers

Description

The Decimate modifier allows you to reduce the vertex/face count of a mesh with minimal shape changes. This is not applicable to meshes which have been created by modeling carefully and economically, where all vertices and faces are necessary to correctly define the shape, but if the mesh is the result of complex modeling, with proportional editing, successive refinements, possibly some conversions from SubSurf to non-SubSurf meshes, you might very well end up with meshes where lots of vertices are not really necessary.

The Decimate modifier is a quick and easy way of reducing the polygon count of a mesh non-destructively. This modifier demonstrates the advantages of a mesh modifier system because it shows how an operation, which is normally permanent and destroys original mesh data, can be done interactively and safely using a modifier.

Unlike the majority of existing modifiers, the Decimate modifier does not allow you to visualize your changes in Edit mode.

Decimate only handles triangles, so each quadrilateral face is implicitly split into two triangles for decimation.

Options



☐ decimate modifier

Ratio

The ratio of faces to keep after decimation, from **0.0** (0%, all faces have been completely removed) to **1.0** (100%, mesh is completely intact, except quads have been triangulated).

As the percentage drops from **1.0** to **0.0**, the mesh becomes more and more decimated until it no longer visually looks like the original mesh.

Face Count (display only)

This field shows the number of remaining faces as a result of applying the Decimate modifier.

Examples

Simple plane

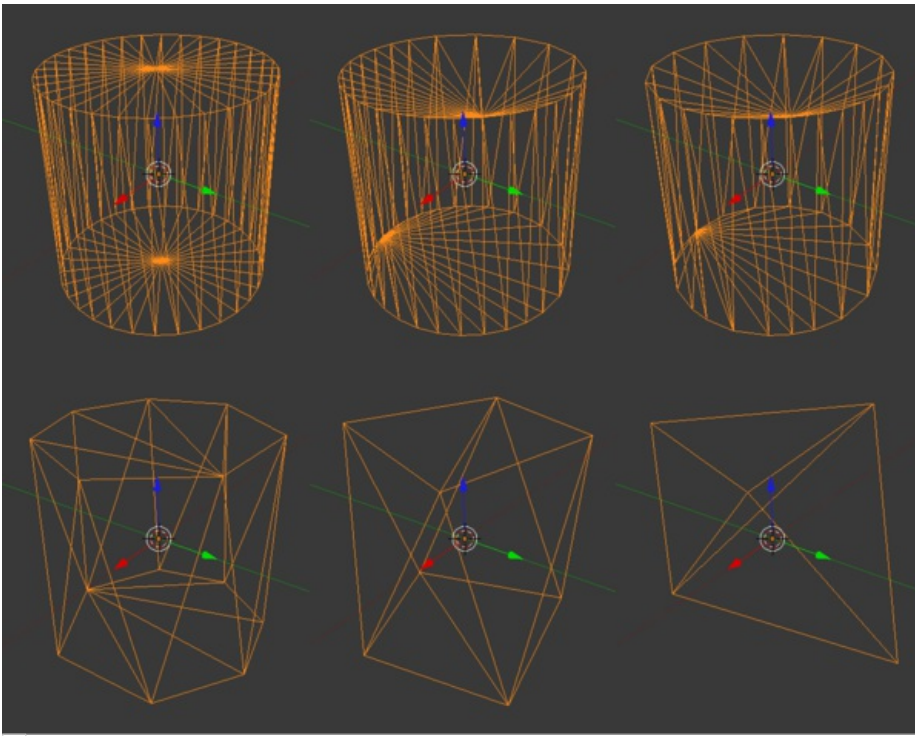
A simple example is a plane, and a 4x4 undeformed Grid object. Both render exactly the same, but the plane has one face and four vertices, while the grid has nine faces and sixteen vertices, hence lots of unneeded vertices and faces. The Decimate modifier allows you to eliminate these unneeded faces.

Decimated cylinder

We take a simple example of decimating a cylinder using the default of **32** segments. This will generate a cylinder with **96** faces. When the Decimate modifier is applied, the face count goes up! This is because the modifier converts all quadrangles (*quads*) into triangles (*tris*) which always increases the face count. Each quad decomposes into two triangles.

The main purpose of the Decimate modifier is to reduce mesh resources through a reduction of vertices and faces, but at the same time maintain the original shape of the object.

In the following picture, the percentage dropped in each successive image, from **100%** to **5%** (a ratio of **0.05**). Notice that the face count has gone from **128** to **88** at a ratio of **0.6 (60%)** and yet the cylinder continues to look very much like a cylinder and we discarded **40** unneeded faces.



1.0 (100%). Faces: 128; 0.8 (80%). Faces: 102; 0.6 (60%). Faces: 88
 0.2 (20%). Faces: 24; 0.1 (10%). Faces: 12; 0.05 (5%). Faces: 6

As you can see when the ratio has reached **0.1**, the cylinder looks more like a cube. And when it has reached **0.05** it doesn't even look like a cube!

Once you have reached the face count and appearance you were looking for you can Apply the modifier. If you want to convert as many of the tris back to quads to reduce mesh resources further you can switch to Edit mode, select all vertices (A), and hit AltJ.

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

EdgeSplit Modifier

Mode: Any mode

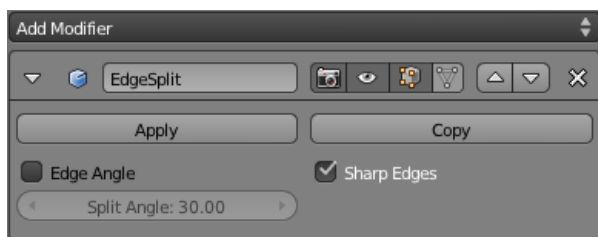
Panel: Modifiers (Editing context, F9)

Description

The EdgeSplit modifier splits edges within a mesh. The edges to split can be determined from the edge angle (i.e. angle between faces forming this edge), and/or edges marked as sharp.

Splitting an edge affects vertex normal generation at that edge, making the edge appear sharp. Hence, this modifier can be used to achieve the same effect as the Autosmooth button, making edges appear sharp when their angle is above a certain threshold. It can also be used for manual control of the smoothing process, where the user defines which edges should appear smooth or sharp (see [Mesh Smoothing](#) for other ways to do this). If desired, both modes can be active at once. The output of the EdgeSplit modifier is available to export scripts, making it quite useful for creators of game content.

Options



EdgeSplit modifier.

From Edge Angle

If this button is enabled, edges will be split if their edge angle is greater than the Split Angle setting.

- The edge angle is the angle between the two faces which use that edge.
- If more than two faces use an edge, it is always split.
- If fewer than two faces use an edge, it is never split.

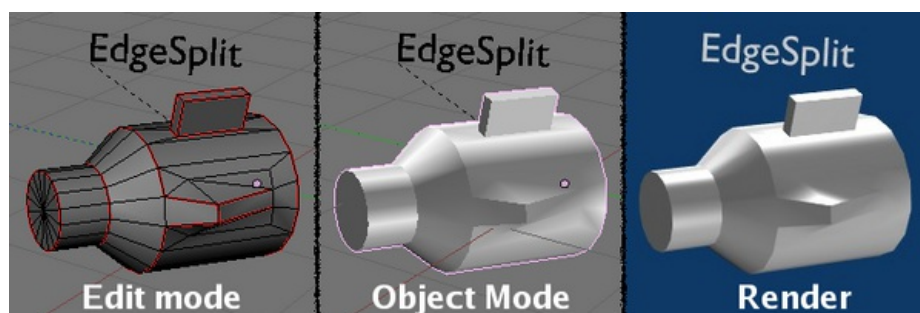
Split Angle

This is the angle above which edges will be split if the From Edge Angle button is selected, from **0°** (all edges are split) to **180°** (no edges are split).

From Marked As Sharp

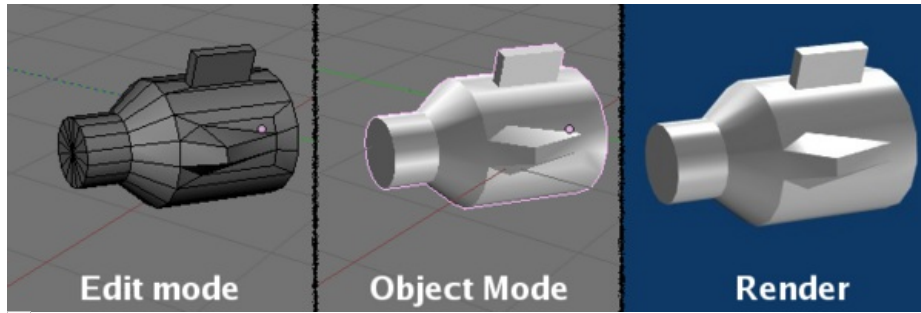
If this button is enabled, edges will be split if they are marked as sharp, using the Edge Specials » Mark Sharp menu item (CtrlE, in Edit mode).

Examples



EdgeSplit modifier output with From Marked As Sharp selected.

[Sample blend file](#)



EdgeSplit modifier output with From Edge Angle selected.
[Sample blend file](#)

Mask Modifier

Mode: Any mode

Panel: Modifiers

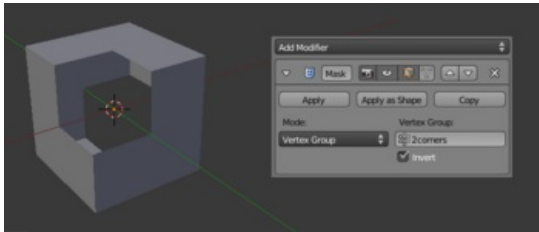
Description

The Mask modifier allows certain parts of an objects mesh to be hidden from view (masked off), in effect making the parts of the mesh that are masked act as if they were no longer there.

Options

Mode

The Mask modifier can hide parts of a mesh based on two different modes, selectable from this drop-down list:



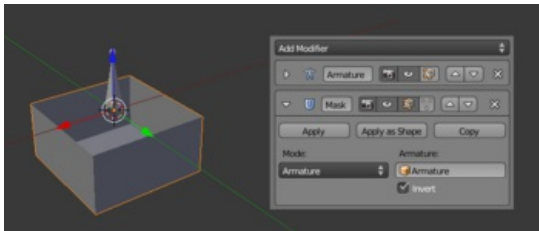
Vertex Group

Vertex Group

When the Vertex Group option is selected, the Mask modifier uses the specified vertex group to determine which parts of the mesh are masked by the modifier.

Once you have entered the desired name, the Mask modifier will update so that anywhere the vertices of the mesh are part of the named vertex group will be masked (which normally means they will be visible), and anything not part of the named vertex group will be made non-visible.

Any of the methods for assigning vertex weights to a mesh work with the Mask modifier, however the actual weight value assigned to a vertex group is completely ignored. The Mask modifier only takes into account whether a set of vertices are part of a group or not, the weight is not taken into account. So having a vertex group weight of say **0.5** will not make a partially masked mesh. Just being part of the vertex group is enough for the Mask modifier, even if the weight is **0.0**.



Armature

Armature

Useful in Pose Mode or when editing an armature. Enter the name of the armature object in the text field field. When working with bones in Pose mode, vertex groups not associated with the active bone are masked. The Inverse button can be useful to see how a bone affects the mesh down the chain of bones.

Inverse

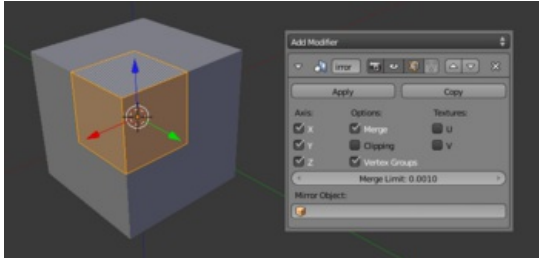
Normally, when the Mask modifier is applied to areas of a mesh, the parts that are under the influence of the modifier are left visible while the parts that aren't are hidden. The Inverse button reverses this behavior, in that now parts of the mesh that were not originally visible become visible, and the parts that were visible become hidden.

Mirror Modifier

Mode: Any mode

Panel: Modifiers

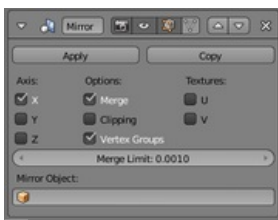
Description



The corner of a cube mirrored across three axes to form... well... a cube.

The Mirror modifier automatically mirrors a mesh along its **local** X, Y and/or Z axes, which pass through the object's center (the mirror plane is then defined by the two other axes). It can also use another object as mirror center, then using this object's local axes instead of its own. It can weld vertices together on the mirror plane within a specified *tolerance* distance. Vertices from the original object can be prevented from moving across or through the mirror plane. And last but not least, it can also mirror vertex groups and UV coordinates.

Options



Mirror modifier

Axis

The axis (X, Y, or Z) along which to mirror (i.e. the axis perpendicular to the mirror plane of symmetry). To understand how the axis applies to the mirror direction, if you were to mirror on the X axis, the X plus values of the original mesh would become X minus values on the mirrored instance.

You can select more than one of these axes – you'll then get more mirror instances, so that all planes of symmetry selected are “fully processed” (i.e. with one axis you get a single mirror, with two axes four mirrors, and with all three axes eight mirrors).

Options


Merge

Merges vertices at the mirror plane. See Merge Limit below.

Clipping

Prevents vertices from crossing through the mirror plane(s). Note that this is only valid in Edit mode (i.e. that when using object transformations, translations, scaling, etcetera, in Object mode, vertices will happily cross these borders.)

If Clipping is selected but vertices are outside of the Merge Limit the vertices will not merge. As soon as the vertices are within Merge Limit they are clipped together and cannot be moved beyond the mirror plane. If several vertices are selected and are at different distances to the mirror plane, they will one by one be clipped at the mirror plane.

Once you have confirmed clipped vertices with LMB  you must, if you want to break the clipping, un-select the Clipping to be able to move vertices away from the mirror.

Vertex Groups

When this button is enabled, the Mirror modifier will try to mirror existing vertex groups. A very nice feature, but that has quite specific prerequisites.

- First, the vertex groups you want to mirror must be named following the usual left/right pattern (i.e. suffixed by something like “.R”, “.right”, “.L”, etcetera).
- Next, you must have the “mirrored” groups already existing (i.e. same names suffixed by the “other side”) *and completely empty* (no vertex assigned to it), else it won't work.

Usually, the mirrored copies of the vertices of a group remain in this group. Once this option is activated, all groups

following the rules described above will only be valid on the original object – the mirrored copy will put these same vertices into the “mirror” group. Very handy with armatures, for example: you just model half of your object, carefully rig it with half of your armature, and just let the Mirror modifier build the other half. Just be sure to put your Armature modifier(s) after the Mirror one.

A final word about multi-axes mirror : in these cases, the “direct”, “first level” copies get the mirrored groups, the copies of copies (“second level”) get the original groups, etcetera.

Textures

The U and V options allows you to mirror, respectively, the U and V texture coordinates. The values are “mirrored” around the **0.5** value, i.e. if you have a vertex with UV coordinates of (**0.3**, **0.85**), its mirror copy will have UV coordinates of (**0.7**, **0.15**) with both buttons enabled.

Merge Limit

The maximal distance between vertices and mirror plane for the welding between original and mirrored vertices to take place. The vertices then will snap together, allowing to link the original mesh to its mirrored copy.

Mirror Object

The name of another object (usually an empty), to be used as reference for the mirror process: its center and axes will drive the plane(s) of symmetry. You can of course animate its position/rotation (lpo curves or others), to animate the mirror effect.

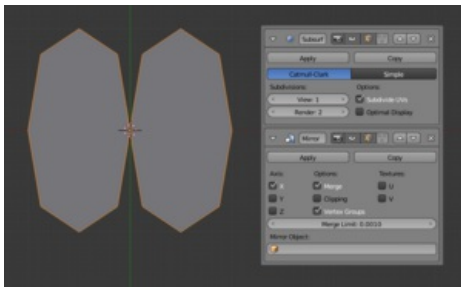
Hints

Many modeling tasks involve creating objects that are symmetrical. However, there used to be no quick way to model both halves of an object without using one of the workarounds that have been discovered by clever Blender artists over the years. A common technique is to model one half of an object and use AltD to create a linked duplicate which can then be mirrored on one axis to produce a perfect mirror-image copy, which updates in realtime as you edit.

The Mirror modifier offers another, simpler way to do this. Once your modeling is completed you can either click Apply to make a real version of your mesh or leave it as is for future editing.

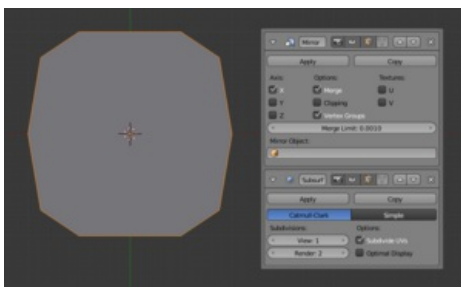
Using Mirror modifier with Subdivision Surface modifier

When using the Mirror modifier along with the Subsurf modifier, the order in which the modifiers are placed is important.



Subsurf modifier before Mirror modifier

This shows the Subsurf modifier placed before the Mirror one, as you can see the effect of this is that the mesh splits down the center line of the mirror effect.



Mirror modifier before Subsurf modifier

This shows the Mirror modifier placed before the Subsurf modifier. In this order you will get the the center line of the mesh snapped to the center line, which in most cases would be the desired effect.

Aligning for Mirror

To apply a Mirror modifier, it is common to have to move the object's center onto the edge or face that is to be the axis for mirroring. This can be tricky when attempted visually. A good technique to achieve an exact position is to determine the edge against which you wish to mirror. Select two vertices on that edge. Then use **⇧ ShiftS** followed by Cursor to Selection (C). This will center the 3D cursor exactly on the edge midway between the two vertices. Finally, pres **CtrlAlt⇧ ShiftC** for the Set Origin popup, then select Origin to 3D Cursor (T). This will move the object's center to where the 3D cursor is located, and the mirroring will be exact.

An alternative is to use an Empty as a Mirror Object that you move to the correct position.


Page status ([reviewing guidelines](#))

Text no detail or img

Proposed fixes: [X](#)

Multiresolution Modifier

Mode: Object mode

Panel: Properties Window -> Context Button Modifiers 

The Multiresolution modifier gives the ability to subdivide a mesh to different levels depending on whether you are viewing it from the 3D Viewport, Sculpt Mode or a Blender Render.

Options

Catmull-Clark / Simple

Set the type of subdivision. Simple maintains the current shape, and simply subdivides edges. Catmull-Clark creates a smooth surface, smaller than the original.

Preview

Set the level of subdivisions to use in the viewport.

Sculpt

Set the number of subdivisions to use in Sculpt Mode.

Render

Set the number of subdivisions to use when rendering.

Subdivide

Add a higher level of subdivision.

Delete Higher

Deletes all subdivision levels that are higher than the current one.

Reshape

Copies vertex coordinates from another mesh. To use, select a different mesh with matching topology and vertex coordinates, then ⇧ Shift select the mesh and click Reshape. The mesh will take the shape of the other one.

Apply Base

Modifies the mesh to match the form of the subdivided mesh.

Optimal Display

Skips the drawing of edges added from subdivision.

Save External

Saves displacements to an external .btx file.

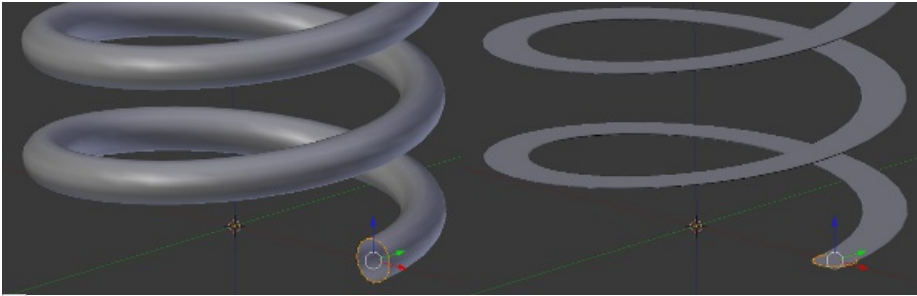
Screw Modifier

Mode: Any mode

Panel: Modifiers

Description

The Screw modifier is similar to the Screw tool in the Tool Shelf in that it takes a profile object, a Mesh or a Curve, to create a helix-like shape.



Properly aligning the profile object is important

The profile should be two dimensional and properly aligned to the cardinal direction of the object rather than to the screw axis.

Options



Screw modifier

Axis

The axis along which the helix will be built.

Screw

The height of one helix iteration.

AxisOb

The name of an object to define the axis direction.

Object Screw

Use the Axis Object to define the value of Screw.

Angle

Degrees for a single helix revolution.

Steps

Number of steps used for a single revolution (displayed in the 3D view.)

Render Steps

As above, used during render time. Increase to improve quality.

Calc Order

Order of edges is calculated to avoid problems with normals. Only needed for meshes, not curves.

Flip

Flip normals direction.

Iterations

Number of revolutions.

Skin Modifier

Mode: Any mode

Panel: Modifiers



A work in progress page is available [here](#).

Description

The Skin modifier uses vertices and edges to create a skinned surface, using a per vertex radius to better define the shape.

Options

[File:25-Manual-Modifiers-Skin.png](#)

Skin modifier

Branch Smoothing

Smooth the intersection vertices.

Hints

- example

Solidify Modifier

Mode: Any mode

Panel: Modifiers

Description

The Solidify modifier takes the surface of any mesh and adds a depth to it.

Originally written as a stand alone script by Campbell Barton (a.k.a Ideasman), Solidify was [included in Blender 2.44](#) and finally transformed into a modifier in Blender 2.5.

Options



Solidify modifier

Thickness

The depth to be solidified.

Offset

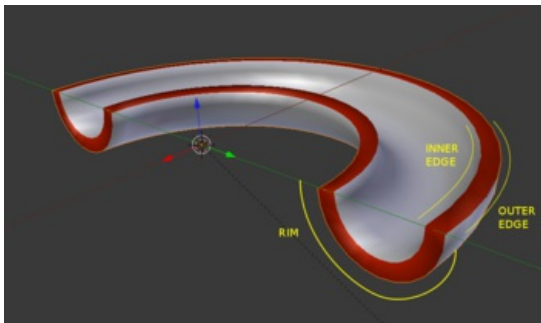
A value between **-1** and **1** to locate the solidified output inside or outside the original mesh. Set to zero, Offset will center the solidified output on the original mesh.

Vertex Group

Restrict the modifier to only this vertex group.

Invert

Inverts the previous selection.



Rim and edges. In this example, the object was assigned a second material used to color the rim red.

Crease

These options are intended for usage with the [Subdivision Surface](#) modifier.

Inner

Assign a crease to the inner edges.

Outer

Assign a crease to the outer edges.

Rim

Assign a crease to the rim.

Even Thickness

Maintain thickness by adjusting for sharp corners. Sometimes improves quality but also increases computation time.

High Quality Normals

Normals are calculated to produce a more even thickness. Sometimes improves quality but also increases computation time.

Fill Rim

Fills the gap between the inner and outer edges.

Rim Material

Uses the object's second material for the rim, this is applied as an offset from the current material.

Hints

- The modifier thickness is applied before object scale, if maintaining a fixed thickness is important use unscaled objects (or account for the scale).
- Solidify thickness is an approximation, while "Even Thickness" and "High Quality Normals", should yield good results, The architectural/CAD modeling the final wall thickness isn't guaranteed, depending on the mesh topology. To look at it differently - maintaining precise wall thickness in some cases would need to add / remove faces on the offset shell - something this modifier doesn't do since this would add a lot of complexity and slow down the modifier.

Page status ([reviewing guidelines](#))

Text

wrong Hotkey

Images

need example

Proposed fixes: [X](#)

Subsurf Modifier

Mode: Any Mode

Panel: Modifiers

Hotkey: F1F2

Description

Subdivision Surface is a method of subdividing the faces of a mesh to give a smooth appearance, to enable modeling of complex smooth surfaces with simple, low-vertex meshes. This allows high resolution mesh modeling without the need to save and maintain huge amounts of data and gives a smooth *organic* look to the object. With any regular mesh as a starting point, Blender can calculate a smooth subdivision on the fly, while modeling or while rendering, using a simple dummy subdivision surface (Subsurf in short), or the smarter Catmull-Clark one.

Options



Modifier's panel

Subsurf is a [modifier](#). To add it to a mesh, press Add Modifier and select Subdivision Surface from the list.

Catmull-Clark/Simple

Select either to choose the subdivision algorithm:

- Simple – Just subdivides the surfaces, without any smoothing (similar to Number of Cuts $W \rightarrow$ Subdivide, in Edit mode). Rarely useful!
- Catmull-Clark – Default option, subdivides and smooths the surfaces.

Subdivisions

Defines the resolution in the 3D View and during Render time.

Note

These two settings allow you to keep a fast and lightweight approximation of your model when interacting with it in 3D, but use a higher quality version when rendering.

Options

- Optimal Display: Restricts the wireframe display to only show the original mesh cage edges, rather than the subdivided result, to help visualization.
- Subdivide UVs: When enabled, the UV maps will also be subsurfed (i.e. Blender will add “virtual” coordinates for all sub-faces created by this modifier).

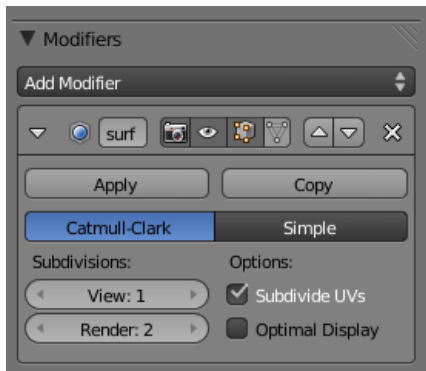
To view and edit the results of the subdivision (“isolines”) while you’re editing the mesh, you must enable the Editing Cage mode by clicking in the gray circle in the modifier panel header (next to the arrows for moving the modifier up and down the stack). This lets you grab the points as they lie in their new subdivided locations, rather than on the original mesh.

Subdivision Surfaces

Description

Subdivision Surface is a method of subdividing the faces of a mesh to give a smooth appearance, to enable modeling of complex smooth surfaces with simple, low-vertex meshes. This allows high resolution mesh modeling without the need to save and maintain huge amounts of data and gives a smooth *organic* look to the object. With any regular mesh as a starting point, Blender can calculate a smooth subdivision on the fly, while modeling or while rendering, using a simple dummy subdivision surface (Subsurf in short), or the smarter Catmull-Clark one.

Options



Subdivision Surface Modifier.

Subdivision Surface is a [modifier](#). To add it to a mesh, select Modifiers, press Add Modifier and select Generate→Subdivision Surface from the list.

Type

This toggle button allows you to choose the subdivision algorithm:

- Catmull-Clark – Default option, subdivides and smooths the surfaces.
- Simple – Just subdivides the surfaces, without any smoothing (similar to Levels time W → Subdivide, in Edit mode). Rarely useful!

View

Defines the display resolution, or level of subdivision *for Blender 3D views*.

Render

This is the subdivision level *used during rendering*.

Note

These two settings allow you to keep a fast and lightweight approximation of your model when interacting with it in 3D, but use a higher quality version when rendering.

Subdivide UVs

When enabled, the UV maps will also be subsurfed (i.e. Blender will add “virtual” coordinates for all sub-faces created by this modifier).

Optimal Display

Restricts the wireframe display to only show the original mesh cage edges, rather than the subdivided result, to help visualization.

Weighted creases for subdivision surfaces

Mode: Edit Mode (Mesh)

Panel: 3D View → Transform Properties

Menu: Mesh → Edges → Crease Subsurf

Description

Weighted edge creases for subdivision surfaces allows you to change the way Subsurf subdivides the geometry to give the edges a smooth or sharp appearance.

Options

The crease weight of selected edges can be changed using Transform Properties (N) and change the Median Transform slider. A higher value makes the edge “stronger” and more resistant to subsurf. Another way to remember it is that the weight refers to the edge’s sharpness. Edges with a higher weight will be deformed less by subsurf. Recall that the subsurfed shape is a product of all intersecting edges, so to make the edges of an area sharper, you have to increase the weight of all the surrounding edges.

Armature Modifier

Mode: Object mode

Panel: Modifiers

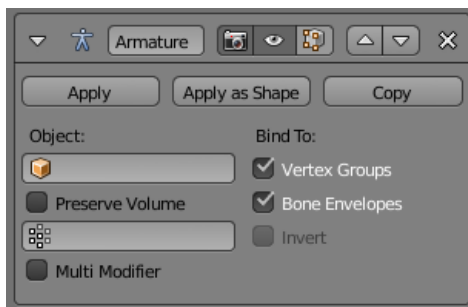
Description

The Armature modifier is used for building skeletal systems for animating the poses of characters and anything else which needs to be posed. With the Vertex Group and Multi Modifier options, you can use several armatures to animate a single (mesh) object.

By adding an armature system to an object, that object can be deformed accurately so that geometry doesn't have to be animated by hand. The Armature modifier allows objects to be deformed by bones simply by specifying the name of the armature object, without having to use the (old) "parent/child" system.

For more details on armatures usage, see [this chapter](#).

Options



Armature modifier

Object

The name of the armature object used by this modifier.

Preserve Volume

Use quaternions to get smoother and nicer rotation interpolations.

Vertex Group

The name of a vertex group of the object, of which weights will be used to determine the influence of this Armature modifier's result when mixing it with the results from other Armature ones. Only meaningful when having at least two of these modifiers on the same object, with Multi Modifier activated.

MultiModifier

Use the same data as previous (Armature?) modifier as input. This allows you to use several armatures to deform a same object, all based on the "non-deformed" data (i.e. this avoid the second Armature modifier to deform the result of the first one...). The results of the Armature modifiers are then mixed together, using the weights of the VGroup vertex groups as "mixing guides".

Bind To

Method to bind the armature to the mesh.

Vertex Groups

Enable/Disable vertex groups defining the deformation (i.e. bones of a given name only deform vertices belonging to groups of same name).

Bone Envelopes

Enable/Disable bone envelopes defining the deformation (i.e. bones deform vertices in their neighborhood).

Invert

Inverts the influence set by the vertex group defined in previous setting (i.e. reverts the weight values of this group).

Page status ([reviewing guidelines](#))

Partial page Text need example

Proposed fixes: [X](#)

Cast Modifier

Mode: Any mode

Panel: Modifiers

Description

This modifier shifts the shape of a mesh, curve, surface or lattice to any of a few pre-defined shapes (sphere, cylinder, cuboid).

It is equivalent to the To Sphere tool in the Editing context (Mesh → Transform → To Sphere Alt+ ShiftS) and what other programs call “Spherify” or “Spherize”, but, as written above, it is not limited to casting to a sphere.

Hint

The [Smooth modifier](#) is a good companion to Cast, since the casted shape sometimes needs smoothing to look nicer or even to fix shading artifacts.

Important

For performance, this modifier works only with local coordinates. If the modified object looks wrong, you may need to apply the object’s rotation (CtrlA), specially when casting to a cylinder.

Options



cast modifier

Cast Type

Menu to choose cast type (target shape): Sphere, Cylinder or Cuboid.

X, Y, Z

Toggle buttons to enable/disable the modifier in the X, Y, Z axes directions (X and Y only for Cylinder cast type).

Factor

The factor to control blending between original and cast vertex positions. It’s a linear interpolation: **0.0** gives original coordinates (aka modifier has no effect), **1.0** casts to the target shape. Values below or above [0.0, 1.0] deform the mesh, sometimes in interesting ways.

Radius

If non-zero, this radius defines a sphere of influence. Vertices outside it are not affected by the modifier.

Size

Alternative size for the projected shape. If zero, it is defined by the initial shape and the control object, if any.

From radius

If activated, calculate Size from Radius, for smoother results.

Vertex Group

A vertex group name, to restrict the effect to the vertices in it only. This allows for selective, realtime casting, by painting vertex weights.

Control Object

The name of an object to control the effect. The location of this object's center defines the center of the projection. Also, its size and rotation transform the projected vertices. Hint: animating (keyframing) this control object also animates the modified object.

Curve Modifier

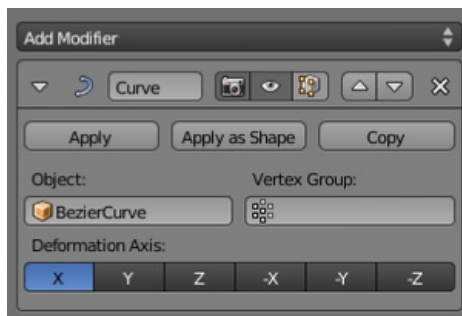
Mode: Object mode

Panel: Modifiers

Description

The Curve modifier functions just like its [predecessor](#) with the added exception that there is no need for a parent/child relationship between the curve and the object being deformed, and that the effect can be applied to all object types in realtime.

Options



Curve modifier

Object

The name of the curve object that will affect the deformed object.

Vertex Group

A vertex group name within the deformed object. The modifier will only affect vertices assigned to this group.

Deformation Axis

X, Y, Z, -X, -Y, -Z: This is the axis that the curve deforms along.

Displace Modifier

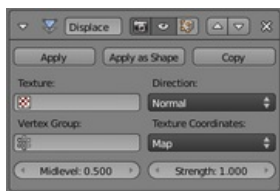
Mode: Any mode

Panel: Modifiers

Description

The Displace modifier displaces vertices in a mesh based on the intensity of a texture. Either procedural or image textures can be used. The displacement can be along a particular local axis, along the vertex normal, or the separate RGB components of the texture can be used to displace vertices in the local X, Y and Z directions simultaneously.

Options



Displace modifier

Texture

The name of the texture from which the displacement for each vertex is derived.
If this field is empty, the modifier defaults to 1.0 (white).

Vertex Group

The name of a vertex group which is used to control the influence of the modifier.
If VGroup is empty, the modifier affects all vertices equally.

Midlevel

The texture value which will be treated as no displacement by the modifier. Texture values below this value will result in negative displacement along the selected direction, while texture values above this value will result in positive displacement. This is achieved by the equation $(\text{displacement}) = (\text{texture value}) - \text{Midlevel}$.

Recall that color/luminosity values are typically between **0.0** and **1.0** in Blender, and not between **0** and **255**.

Direction

The direction along which to displace the vertices.
Can be one of the following:

- X – displace along local X axis.
- Y – displace along local Y axis.
- Z – displace along local Z axis.
- RGB -> XYZ – displace along local XYZ axes individually using the RGB components of the texture.
- Normal – displace along vertex normal.

Texture Coordinates

The texture coordinate system to use when retrieving values from the texture for each vertex.
Can be one of the following:

- UV – take texture coordinates from face UV coordinates.

UV Layer

The UV coordinate layer from which to take texture coordinates.

If the object has no UV coordinates, it uses the Local coordinate system. If this field is blank, but there is an UV coordinate layer available (e.g. just after adding the first UV layer to the mesh), it will be overwritten with the currently active UV layer.

Note

Since UV coordinates are specified per face, the UV texture coordinate system currently determines the UV coordinate for each vertex from the first face encountered which uses that vertex; any other faces using that vertex are ignored. This may lead to artifacts if the mesh has non-contiguous UV coordinates.

- Object – take the texture coordinates from another object's coordinate system (specified by the Object field).

Object

The object from which to take texture coordinates. Moving the object will therefore alter the coordinates of the texture

mapping. Take note that moving the original object will **also** result in a texture coordinate update. As such, if you need to maintain a displacement coordinate system while moving the object to which the displacement is set, you will also have to move the related object at the same rate and direction. If this field is blank, the Local coordinate system is used.

- Global – take the texture coordinates from the global coordinate system.
- Local – take the texture coordinates from the object's local coordinate system.

Strength

The strength of the displacement. After offsetting by the Midlevel value, the displacement will be multiplied by the Strength value to give the final vertex offset. This is achieved by the equation $(\text{vertex_offset}) = (\text{displacement}) \times \text{Strength}$.

A negative strength can be used to invert the effect of the modifier.

See also

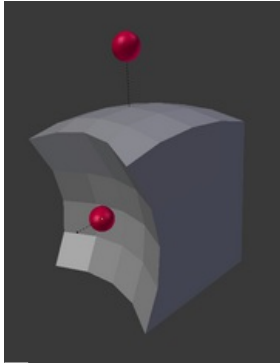
- Blender artists post: [Displace modifier tutorial](#) (September 2006)

Hook Modifier

Mode: Any mode

Panel: Modifiers

Description



Two spheres used as Hooks to deform a subdivided cube.

The Hook modifier is used together with Shape Keys to control the deformation of a Mesh or a Lattice using another object (usually an Empty but it can be any object).

As the hook moves, it weighted-pulls vertices from the mesh with it. If you have used proportional editing, you can think of it as animated proportional editing. While hooks do not give you the fine control over vertices movement that shape keys do, they are much simpler to use.

Options



Hook modifier

Object

The parent object name for the hook.

Falloff

If not zero, the falloff is the distance where the influence of a hook goes to zero. It uses a smooth interpolation, comparable to the [proportional editing tool](#).

Force

Since multiple hooks can work on the same vertices, you can weight the influence of a hook this way. Weighting rules are:

- If the total of all forces is smaller than **1.0**, the remainder ($1.0 - (\text{forces sum})$), will be the factor the original position have as force.
- If the total of all forces is larger than **1.0**, it only uses the hook transformations, averaged by their weights.

The following settings are only available in Edit mode:

Reset

Recalculate and clear the offset transform of hook.

Recenter

Set hook center to cursor position.

Select

Select affected vertices on mesh.

Reassign


Reassigns selected vertices to this hook.

Hints

- The hook modifier stores vertex indices's on the original mesh to effect, this means modifiers that generate geometry like subsurf should always be applied **after** the hook modifier otherwise the generated geometry will be left out of the hooks influence.

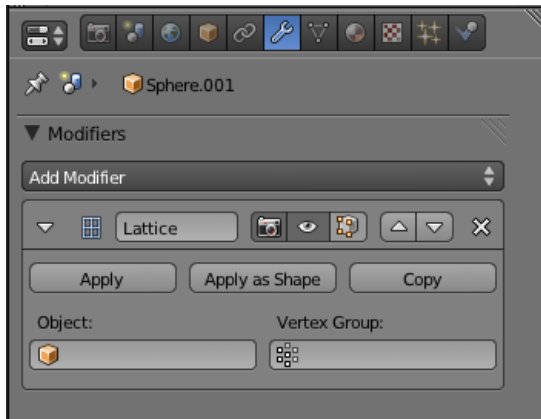
Lattice Modifier

Mode: Object mode

Panel: Properties Window -> Context Button Modifiers 

The Lattice modifier deforms the base object according to the shape of a Lattice object.

Options



Lattice modifier.

Object

The Lattice object with which to deform the base object.

Vertex Group

An optional vertex group name which lets you limit the modifier effect to a part of the base mesh.

Hints

You can control the Lattice object attributes in the Object Data context for the Lattice in the Properties Window .

A lattice consists of a non-renderable three-dimensional grid of vertices. Their main use is to give extra deformation capabilities to the underlying object they control (either *via* a modifier, or being its parent). These “victim” objects can be meshes, curves, surfaces, text, lattices and even particles.

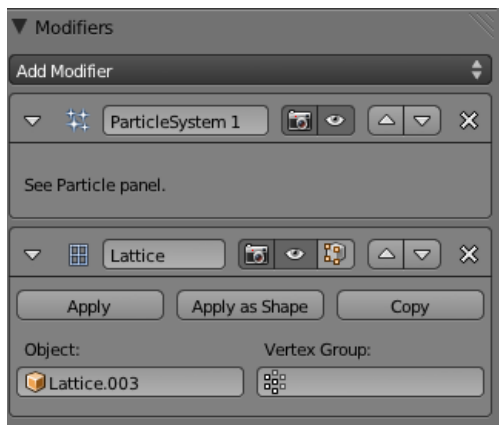
Why would you use a lattice to deform a mesh instead of deforming the mesh itself in Edit mode? There are a couple of reasons for that:

- First of all: it's easier. Since your mesh could have a zillion vertices, scaling, grabbing and moving them could be a hard task. Instead, if you use a nice simple lattice your job is simplified to move just a couple of vertices.
- It's nicer. The deformation you get looks a lot better!
- It's fast! You can use the same lattice to deform several meshes. Just give each object a lattice modifier, all pointing to the same lattice.
- It's a good practice. A lattice can be used to get different versions of a mesh with minimal extra work and consumption of resources. This leads to an optimal scene design, minimizing the amount of modeling work. A lattice does not affect the texture coordinates of a mesh's surface. Subtle changes to mesh objects are easily facilitated in this way, and do not change the mesh itself.

Example/Tutorial(s)

There are example tutorials for 2.4 versions in the [Tutorials](#) section. One 2.5-tutorial shows how to [shape a fork](#).

Particles and Lattices



Particles following a lattice.

Particles follow a Lattice if the modifier sequence is right. First the particles, then the lattice!

Mesh Deform Modifier

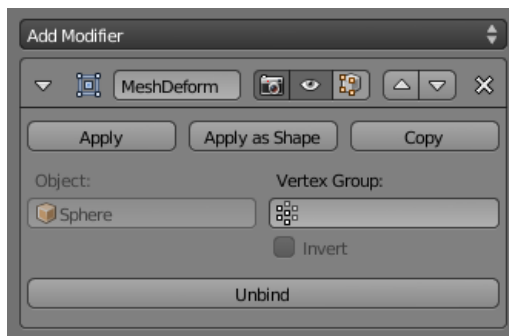
Mode: All modes

Panel: Modifiers

Description

The Mesh Deform modifier allows an arbitrary closed mesh (of any closed shape, not just the cuboid shape of a Lattice modifier) to act as a deformation cage around another mesh.

Options



Mesh Deform modifier

The Mesh Deform modifier is reasonably easy to use but it can be very slow to do the calculations it needs, to properly map the deform mesh cage to the deformed object.

Object

The name of the mesh object to be used as a deforming mesh cage.

Vertex Group

An optional vertex group that will be affected by the deforming mesh cage.

Invert

Inverts the influence set by the vertex group defined in previous setting (i.e. reverts the weight values of this group).

Bind

The Bind button is what tells the Mesh Deform modifier to actually link the deform mesh cage to the deformed object, so that altering the shape of the deform mesh cage actually alters the shape of the deformed object.

Be aware that depending on the settings of the Mesh Deform modifier and complexity of the deform mesh cage and/or deformed object, it can take a long time for this operation to complete. This can result in Blender not responding to user's actions until it has completed, it is even possible that Blender will run out of memory and crash.

Unbind

When a deformed object has been associated to a deform mesh cage, it can later be disassociated by selecting the Unbind button which replaced the Bind one.

When Unbind is clicked, the *deform mesh cage* will keep its current shape, it will not reset itself back to its original start shape. If you need its original shape, you will have to save a copy of it before you alter it. The deformed object will however reset back to its original shape that it had before it was binded to the deform mesh cage.

Precision

The Precision numeric slider field controls that accuracy with which the deform mesh cage alters the deformed object, when the points on the cage are moved.

The range of values for the Precision field can range from **2** to **10**, the default being **5**. Raising this value higher can greatly increase the time it takes the Mesh Deform modifier to complete its binding calculations, but it will get more accurate cage mapping to the deformed object. This rise in calculation time can make Blender stop responding until it has calculated what it needs to. As well as making Blender not respond, raising the Precision value high and then trying to Bind on a very complex deform mesh cage and/or deformed object can use large amounts of memory and in extreme cases crash Blender. To be safe, save your blend file before proceeding!

This setting becomes unavailable once a cage has been bound.

Dynamic

The Dynamic button indicates to the Mesh Deform modifier that it should also take into account deformations and changes to the underlying deformed object which were not a direct result of deform mesh cage alteration.

With Dynamic button activated, other mesh altering features (such as other modifiers and shape keys) are taken into account when binding a deform mesh cage to the deformed object, increasing deformation quality. It is deactivated by default to save memory and processing time when binding...

As Precision, this setting is unavailable once a cage has been bound.

See Also

- The [Lattice modifier](#).

Page status ([reviewing guidelines](#))

Images needs an example

Proposed fixes: none

Shrinkwrap Modifier

Mode: All modes

Panel: Modifiers

Description

The Shrinkwrap modifier allows an object to “shrink” to the surface of another object. It moves each vertex of the object being modified to the closest position on the surface of the given mesh (using one of the three methods available). It can be applied to meshes, lattices, curves, surfaces and texts.

As for most of the deform modifiers, the affected “vertices” are the “computed” one, i.e. the real geometry of the object at the time the modifier is calculated, and not the original *vertices*/control points.

Something of a view-independent [retopo tool](#) (in Blender 2.49), Shrinkwrap projects vertices along their normals or moved to the nearest surface point. But it doesn't give accuracy problems as retopo did, since it works in object space instead of image space. Also it's possible to “keep a distance” from the target position.

Note

For those who found the Shrinkwrap modifier pretty useful, but would like it to move empties or objects positions... Have a look at the [Shrinkwrap constraint!](#)

Options

Target

Shrink target, the mesh to shrink/wrap around.

Vertex Group

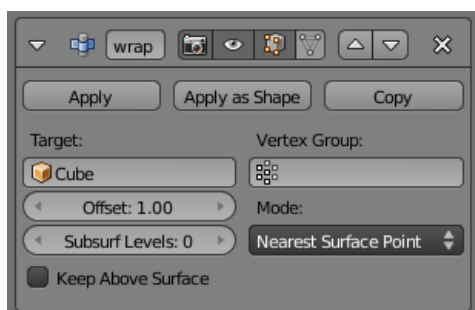
The weight paint for this vertex group of the current modified mesh controls whether and how much each vertex is displaced to its target position. If a vertex is not a member of this group, it is not displaced (same as weight 0).

Offset

The distance that must be kept from the calculated target position, in Blender Units.

Subsurf Levels

This should apply a (temporary) Catmull-Clark subsurf to the modified object (or it's target?), before computing the wrap... But it does not seem to have any effect...



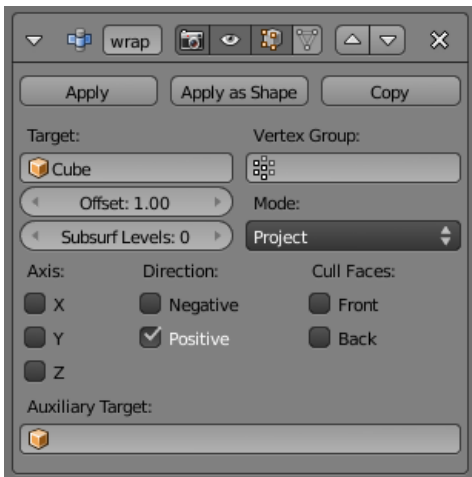
Nearest Surface Point

Mode

This drop-down list specifies the method to be used to determine the nearest point on the target's surface for each vertex of the modified object. Some options will add some extra, specific controls to the panel.

Nearest Surface Point

This will select the nearest point over the surface of the shrink target. It adds the extra option Above surface, which always keep the computed vertices above their "floor faces". This is only meaningful when Offset is not null.



Project

Projection

This will project vertices along a chosen axis until they touch the shrink target. Vertices that never touches the shrink target are left in their original position. This implies that, depending on the settings of this option and the relative positions of the two objects, the modified object might sometimes remain undeformed. This is not a bug, just “play” with the settings (especially the Negative/Positive ones), or move one of the objects around...

This method is the hardest to master, as it might sometimes gives unexpected results... It adds quite a few extra options:

X, Y, Z

Along which local axis of the modified object the projection is done. These options can be combined with each other, yielding a “median axis” of projection.

Negative, Positive

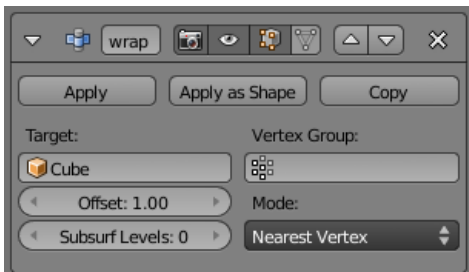
This allows you to select the allowed direction(s) of the shrink along the selected axis. With more than one Shrinkwrap modifier, negative and positive axes can be combined.

Cull Faces

This allows you to prevent any projection over the “front side” (respectively the “back side”) of the target’s faces. The “side” of a face is determined by its normal (front being the side “from where” the normal “originates”).

Auxiliary Target

An additional object to project over.



Nearest Vertex

Nearest Vertex

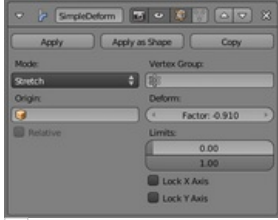
This will select the nearest vertex of the shrink target. It adds no extra option.

Simple Deform Modifier

Mode: All modes

Panel: Modifiers

Description



Simple Deform

The Simple Deform modifier allows to easily apply some simple deformation to an object (meshes, lattices, curves, surfaces and texts are supported).

As for most of the deform modifiers, the deform functions are applied to the “computed vertices”, i.e. to the real geometry of the object at the time the modifier is calculated, and not to the original *vertices*/control points. This means you can increase the level of detail of the deform effect by first inserting a Subdivision Surface modifier (for meshes), or raising the Preview Resolution settings (for curves/surfaces/texts).

Using another object, it's possible to define the axis and origin of the deformation, allowing to apply very different effects.

Options

Mode

This drop-down list defines the deform function applied, among four available:

- Twist – Rotates around the Z axis.
- Bend – Bends the mesh over the Z axis.
- Taper – Linearly scales along Z axis.
- Stretch – Stretches the object along the Z axis (negative Factor leads to squash).

Vertex Group

The name of the vertex group that indicates whether and how much each vertex is influenced by the deformation.

Origin

The name of an object that defines the origin of deformation (usually an empty). This object can be:

- Rotated to control axis (as it is its Z axis that is now used as “guide”).
- Translated to control the origin of deformation.
- Scaled to change the deform factor.

Note

When the object controlling the origin (the one in the Origin field) is a child of the deformed object, this creates a cyclic dependency in Blender's data system (the DAG – “dependency graph”). The work around is to create an empty and attach both objects to it.

Factor

The amount of deformation. Can be set to negative.

Limits

These settings allow you to set the lower and upper limits of the deformation (they are proportional values, from **0.0** to **1.0**). Obviously, upper limit can't be lower than lower Limit.

Lock X Axis/Lock Y Axis (Taper and Stretch modes only)

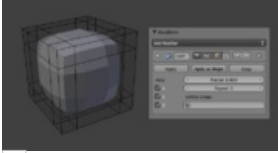
This controls whether the X and/or Y coordinates are allowed to change or not. Thus it is possible to squash the X coordinates of an object and keep the Y coordinates intact.

Smooth Modifier

Mode: Any mode

Panel: Modifiers

Description



Smooth modifier applied to a subdivided cube



As above, with a vertex group selected

This modifier smooths a mesh by flattening the angles between adjacent faces in it, just like Smooth in the Editing context. So it smooths without subdividing the mesh – the number of vertices remains the same.

This modifier is not limited to smoothing, though. Its control factor can be configured outside the **[0.0, 1.0]** range (including negative values), which can result in interesting deformations, depending on the affected mesh.

Options

X, Y, Z

Toggle buttons to enable/disable the modifier in the X, Y and/or Z axes directions.

Factor

The factor to control smoothing amount. The smoothing ranges from **0.0** to **1.0** (**0.0**: disabled, **0.5**: same as the Smooth button, **1.0**: maximum). Alternatively, values outside this range (above **1.0** or below **0.0**) distort the mesh.

Repeat

The number of smoothing iterations, equivalent to pressing the [Smooth](#) button multiple times.

Vertex Group

A vertex group name, to restrict the effect to the vertices in it only. This allows for selective, realtime smoothing, by painting vertex weights.

Page status ([reviewing guidelines](#))

Images Requires image to show function.

Proposed fixes: none

Warp Modifier

This deformation modifier can be used to warp parts of a mesh to a new location in a very flexible way by using 2 objects to select the "from" and "to" regions with options for using a curve falloff, texture and vertex group.

The Warp Modifier is a bit tricky at first, but its helps to understand how it is working. The modifier requires two points, specified by object centers. The "from" point designates a point in space that is pulled toward the "to" point. It is akin to using the [Proportional Editing](#) in edit mode.

Options

From:

Specify the origin object transformation of the warp.

To:

Specify the destination object transformation of the warp.

Preserve Volume

Enables volume preservation when rotating one of the transforms.

Vertex Group

Limit the deformation to a specific vertex group.

Strength

Sets how strong the effect is.

Radius

Sets the distance from the transforms that can be warped by the transform handles.

Falloff Type

Sets the way the strength of the warp is as it goes from the center of the transform to the Radius value. See [Proportional Editing](#) for descriptions of the falloff types.

Texture

Specify a texture the strength is offset by to create variation in the displacement.

Texture Coordinates

Set the way textures are applied to the mesh when using a textured warp.

Object

Specify an object to use when set to Object.

UV Layer

Specify a UV layer when set to UV.

Wave Modifier

Mode: Object mode

Panel: Modifiers

Description

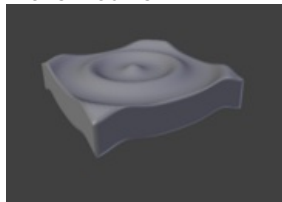
The Wave modifier adds an ocean-like motion to the Z coordinate of the object's vertices/control points. This modifier is available for meshes, lattices, curves, surfaces and texts, with a few restrictions for non-*mesh* objects:

- Activating Normals or typing a name in VGroup will then simply deactivate the modifier.
- Even worse, selecting UV as texture coordinates will make Blender crash at once!

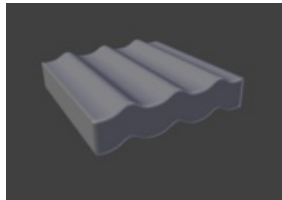
Options



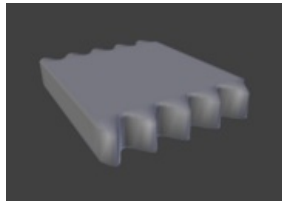
Wave modifier



Circular wave front



Linear wave front



Motion enabled for X and
Normals enabled for Y

Motion

X, Y, Cyclic: The wave effect deforms vertices/control points in the Z direction, originating from the given starting point and propagating along the object with circular wave fronts (both X and Y activated), or with rectilinear wave fronts, then parallel to the axis corresponding to the X or Y button activated. Cyclic repeats the waves cyclically, rather than a single pulse.

Normals

For meshes only. Displaces the mesh along the surface normals (instead of the object's Z-axis).

Time

Settings to control time parameters.

Offset

Time offset in frames. The frame at which the wave begins (if Speed is positive), or ends (if Speed is negative). Use a negative frame number to prime and pre-start the waves.

Life

Duration of animation in frames. Set to zero loops the animation for ever.

Damping

An additional number of frames in which the wave slowly dampens from the Height value to zero after Life is reached. The dampening occurs for all the ripples and begins in the first frame after the Life is over. Ripples disappear over Damping frames.

Position

X and Y coordinates of the center of the waves, in the object's local coordinates. Falloff controls how fast the waves fade out as they travel away from the coordinates above. Note that selecting a Start Position Object effectively cancels the coordinates chosen above, but retains the Falloff value.

Start Position Object

Use another object as reference for starting position of the wave. Leave blank to disable. Note that you then can animate this object's position, to change the waves origin along time.

Vertex Group

For meshes only. A vertex group name, used to control the parts of the mesh affected by the wave effect, and to what extent (using vertex weights).

Texture

Use this texture to control the object's displacement level. Animated textures can give very interesting results here.

Texture Coordinates

This menu lets you choose the texture's coordinates for displacement:

Local

Object's local coordinates.

Global

Global coordinates.

Object

Adds an additional field just below, to type in the name of the object from which to get the texture coordinates.

UV

Adds an extra UV Layer drop-down list, where to select the UV layer to be used. **Warning:** do not activate this options with non-mesh objects, it seems to make Blender crash.

Speed

The speed, in BU (for "Blender Units") per frame, of the ripple.

Height

The height or amplitude, in BU, of the ripple.

Width

Half of the width, in BU, between the tops of two subsequent ripples (if Cycl is enabled). This has an indirect effect on the ripple amplitude – if the pulses are too near to each other, the wave may not reach the **0** Z-position, so in this case Blender actually lowers the whole wave so that the minimum is zero and, consequently, the maximum is lower than the expected amplitude. See [technical details](#) below.

Narrowness

The actual width of each pulse, the higher the value the narrower the pulse. The actual width of the area in which the single pulse is apparent is given by $4/\text{Narrow}$. That is, if Narrowness is **1** the pulse is **4** units wide, and if Narrowness is **4** the pulse is **1** unit wide.

Warning

All the values described above must be multiplied with the corresponding Scale values of the object to get the real dimensions. For example, if the value of Scale Z is **2** and the value of Height of the waves is **1**, it gives us final waves with a height of **2 BU**!

Technical Details and Hints

The relationship of the above values is described here:



☐ Wave front characteristics.

To obtain a nice wave effect similar to sea waves and close to a sinusoidal wave, make the distance between following ripples and the ripple width equal, that is the Narrow value must be equal to $2/\text{Width}$. E.g. for Width=1, set Narrow to 2.

Copy This page is a copy of the same page in 2.4 manual, need to be updated

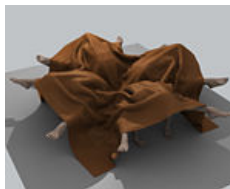
Text Partially

Proposed fixes: none

Cloth Simulation



☐ Cloth example.



☐ Cloth on carved wooden men (made by motorsep).



☐ Cloth example.

Cloth simulation is one of the hardest aspects of CG, because it is a deceptively simple real-world item that is taken for granted, yet actually has very complex internal and environmental interactions. After years of development, Blender has a very robust cloth simulator that is used to make clothing, flags, banners, and so on. Cloth interacts with and is affected by other moving objects, the wind and other forces, as well as a general aerodynamic model, all of which is under your control.

Description

A piece of cloth is any mesh, open or enclosed, that has been designated as cloth. The Cloth panels are located in the Physics sub-context and consist of three panels of options. Cloth is either an open or closed mesh and is mass-less, in that all cloth is assumed to have the same density, or mass per square unit.

Cloth is commonly modeled as a mesh grid primitive, or a cube, but can also be, for example, a teddy bear. However, Blender's [Softbody system](#) provides better simulation of closed meshes; Cloth is a specialized simulation of fabrics.

Once the object is designated as Cloth, a Cloth [modifier](#) will be added to the object's modifier stack automatically. As a [modifier](#) then, it can interact with other modifiers, such as Armature and Smooth. In these cases, the ultimate shape of the mesh is computed in accordance with the order of the modifier stack. For example, you should smooth the cloth *after* the modifier computes the shape of the cloth.

So you edit the Cloth in two places. In the F7 Physics buttons to edit the properties of the cloth and in the Modifier stack where you edit the Modifier properties related to display and interaction with other modifiers.

You can Apply the cloth modifier to freeze, or lock in, the shape of the mesh at that frame, which removes the modifier. For example, you can drape a flat cloth over a table, let the simulation run, and then apply the modifier. In this sense, you are using the simulator to save yourself a lot of modeling time.

Results of the simulation are saved in a cache, so that the shape of the mesh, once calculated for a frame in an animation, does not have to be recomputed again. If changes to the simulation are made, the user has full control over clearing the cache and re-running the simulation. Running the simulation for the first time is fully automatic and no baking or separate step interrupts the workflow.

Computation of the shape of the cloth at every frame is automatic and done in the background; thus you can continue working while the simulation is computed. However it is CPU-intensive and depending on the power of your PC and the complexity of the simulation, the amount of CPU needed to compute the mesh varies as does the lag you might notice.

Don't jump ahead

If you set up a cloth simulation but Blender has not computed the shapes for the duration of the simulation, and if you jump ahead a lot of frames forward in your animation, the cloth simulator may not be able to compute or show you an accurate mesh shape for that frame, if it has not previously computed the shape for the previous frame(s).

Workflow

A general process for working with cloth is to:

1. Model the cloth object as a general starting shape.

2. Designate the object as a "cloth" in the Physics tab of the Properties window.
3. Model other deflection objects that will interact with the cloth. Ensure the Deflection modifier is last on the modifier stack, after any other mesh deforming modifiers.
4. Light the cloth and assign materials and textures, UV-unwrapping if desired.
5. If desired, give the object particles, such as steam coming off the surface.
6. Run the simulation and adjust Options to obtain satisfactory results. The timeline window's VCR controls are great for this step.
7. Optionally age the the mesh to some point in the simulation to obtain a new default starting shape.
8. Make minor edits to the mesh on a frame-by-frame basis to correct minor tears.

Creating Cloth Simulations

This section discusses how to use those options to get the effect you want. First, enable Cloth. Set up for the kind of cloth you are simulating. You can choose one of the presets to have a starting point.

As you can see, the heavier the fabric, the more stiff it is and the less it stretches and is affected by the air.

Cloth Panel

Presets

Contains a number of preset cloth examples, and allows you to add your own.

Quality

Set the number of simulation steps per frame. Higher values result in better quality, but is slower.

Material

Mass

The mass of the cloth material.

Structural

Overall stiffness of the cloth.

Bending

Wrinkle coefficient. Higher creates more large folds.

Damping

Spring

Damping of cloth velocity. Higher = more smooth, less jiggling.

Air

Air has normally some thickness which slows falling things down.

Pinning



Cloth in action.

The first thing you need when pinning cloth are [Vertex Groups](#). There are several ways of doing this including using the Weight Paint tool to paint the areas you want to pin (see the [Weight paint](#) section of the manual).

Once you have a vertex group set, things are pretty straightforward, all you have to do is press the Pinning of cloth button in the Cloth panel and select which vertex group you want to use, and the stiffness you want it at.

Stiffness

Target position stiffness. You can leave the stiffness as it is, default value of 1 is fine.

Collisions

In most cases, a piece of cloth does not just hang there in 3D space, it collides with other objects in the environment. To ensure proper simulation, there are several items that have to be set up and working together:

1. The Cloth object must be told to participate in Collisions.
2. Optionally (but recommended) tell the cloth to collide with itself.
3. Other objects must be visible to the Cloth object *via* shared layers.
4. The other objects must be mesh objects.
5. The other objects may move or be themselves deformed by other objects (like an armature or shape key).
6. The other mesh objects must be told to deflect the cloth object.
7. The blend file must be saved in a directory so that simulation results can be saved.
8. You then Bake the simulation. The simulator computes the shape of the cloth for a frame range.
9. You can then edit the simulation results, or make adjustments to the cloth mesh, at specific frames.
10. You can make adjustments to the environment or deforming objects, and then re-run the cloth simulation from the current frame forward.

Collision Settings



Cloth Collisions panel.

Now you must tell the Cloth object that you want it to participate in collisions. For the cloth object, locate the Cloth Collision panel, shown to the right:

Enable Collisions

LMB  click this to tell the cloth object that it needs to move out of the way.

Quality

A general setting for how fine and good a simulation you wish. Higher numbers take more time but ensure less tears and penetrations through the cloth.

Distance

As another object gets this close to it (in Blender Units), the simulation will start to push the cloth out of the way.

Repel

Repulsion force to apply when cloth is close to colliding.

Repel Distance

Maximum distance to apply repulsion force. Must be greater than minimum distance.

Friction

A coefficient for how slippery the cloth is when it collides with the mesh object. For example, silk has a lower coefficient of friction than cotton.

Self-collisions

Real cloth cannot permeate itself, so you normally want the cloth to self-collide.

Enable Self Collisions

Click this to tell the cloth object that it should not penetrate itself. This adds to simulation compute time, but provides more realistic results. A flag, viewed from a distance does not need this enabled, but a close-up of a cape or blouse on a character should have this enabled.

Quality

For higher self-collision quality just increase the Quality and more self collision layers can be solved. Just keep in mind that you need to have at least the same Collision Quality value as the Quality value.





Distance

If you encounter problems, you could also change the Min Distance value for the self-collisions. The best value is 0.75, for fast things you better take 1.0. The value 0.5 is quite risky (most likely many penetrations) but also gives some speedup.

Regression blend file: [Cloth selfcollisions](#).

Shared Layers

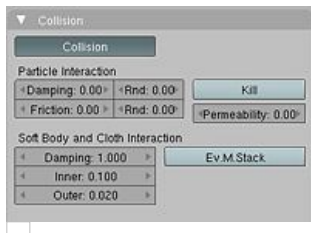
Suppose you have two objects: a pair of Pants on layers 2 and 3, and your Character mesh on layers 1 and 2. You have enabled the Pants as cloth as described above. You must now make the Character “visible” to the Cloth object, so that as your character bends its leg, it will push the cloth. This principle is the same for all simulations; simulations only interact with objects on a shared layer. In this example, both objects share layer 2.

To view/change an object’s layers, RMB  click to select the object in Object mode in the 3D view. M to bring up the “Move Layers” popup, which shows you all the layers that the object is on. To put the object on a single layer, LMB  click the layer button. To put the object on multiple layers, ⇧ Shift LMB  the layer buttons. To remove an object from a selected layer, simply ⇧ Shift LMB  the layer button again to toggle it.

Mesh Objects Collide

If your colliding object is not a mesh object, such as a NURBS surface, or text object, you must convert it to a mesh object. To do so, select the object in object mode, and in the 3D View header, select Object → Convert Object Type (AltC), and select Mesh from the popup menu.

Cloth - Object collisions



Collision settings.

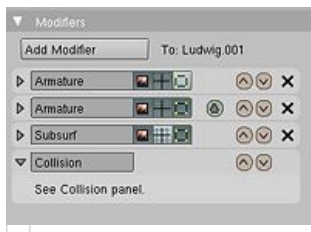
The cloth object needs to be deflected by some other object. To deflect a cloth, the object must be enabled as an object that collides with the cloth object. To enable Cloth - Object collisions, you have to enable deflections on the collision object (not on the cloth object).

In the Buttons window, Object context, Physics sub-context, locate the Collision panel shown to the right. It is also important to note that this collision panel is used to tell all simulations that this object is to participate in colliding/deflecting other objects on a shared layer (particles, soft bodies, and cloth).

Beware

There are three different Collision panels, all found in the Physics sub-context. The first (by default), a tab beside the Fields panel, is the one needed here. The second panel, a tab in the Soft Body group, concern softbodies (and so has nothing to see with clothes). And we have already seen the last one, by default a tab beside the Cloth panel.

Mesh Object Modifier Stack



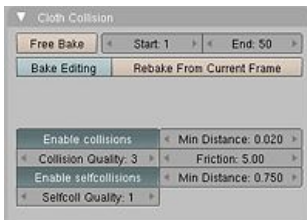
Collision stack.

The object’s shape deforms the cloth, so the cloth simulation must know the “true” shape of that mesh object at that frame. This true shape is the basis shape as modified by shape keys or armatures. Therefore, the Collision modifier must be **after** any of those. The image to the right shows the Modifiers panel for the Character mesh object (not the cloth object).

Cloth Cache

Cache settings for cloth are the same as with other dynamic systems. See [Particle Cache](#) for details.

Bake Collision



After you have set up the deflection mesh for the frame range you intend to run the simulation (including animating that mesh *via* armatures), you can now tell the cloth simulation to compute (and avoid) collisions. Select the cloth object and in the Object context, Physics sub-context, set the Start and End settings for the simulation frames you wish to compute, and click the Bake button.

You cannot change Start or End without clearing the bake simulation. When the simulation has finished, you will notice you have the option to free the bake, edit the bake and re-bake:

There's a few things you'll probably notice right away. First, it will bake significantly slower than before, and it will probably clip through the box pretty bad as in the picture on the right.

Editing the cached simulation=

The cache contains the shape of the mesh at each frame. You can edit the cached simulation, when you baked the simulation and pressed the Bake Editing button. Just go to the frame you want to fix and ⇐ Tab into Edit mode. There you can move your vertices using all of Blender's mesh shaping tools. When you exit, the shape of the mesh will be recorded for that frame of the animation. If you want Blender to resume the simulation using the new shape forward, LMB click 'Rebake from next Frame' and play the animation. Blender will then pick up with that shape and resume the simulation.

Edit the mesh to correct minor tears and places where the colliding object has punctured the cloth.

If you add, delete, extrude, or remove the vertices in the mesh, Blender will take the new mesh as the starting shape of the mesh back to the *first frame* of the animation, replacing the original shape you started with, up to the frame you were on when you edited the mesh. Therefore, if you change the content of a mesh, when you ⇐ Tab out of Edit mode, you should unprotect and clear the cache so that Blender will make a consistent simulation.

Troubleshooting

If you encounter some problems with collision detection there are two ways to fix them:

- The fastest solution would be to put up the Min Distance setting under the Cloth Collision panel. This will be the fastest way to fix the clipping, however, it will be less accurate and won't look as good. Using this method tends to make it look like the cloth is resting on air, and gives it a very rounded look.
- A second method is to increase the Quality (in the first Cloth panel). This results in smaller steps for the simulator and therefore to a higher probability that fast moving collisions get catch. You can also increase the Collision Quality to perform more iterations to get collisions solved.
- If none of the methods help, you can easily edit the cached/baked result in Edit mode afterwards.
- My Cloth is torn by the deforming mesh - he "Hulks Out": Increase its structural stiffness (StructStiff setting, Cloth panel) very high, like 1000.

Subsurf modifier

A bake/cache is done for every subsurf level so please use **one equal** subsurf level for render and preview.

Examples

To start with cloth, the first thing you need, of course, is some fabric. So, let's delete the default cube and add a plane. I scaled mine up along the Y axis, but you don't have to do this. In order to get some good floppy and flexible fabric, you'll need to subdivide it several times. I did it 8 times for this example. So ⇐ Tab into Edit mode, and press W → Subdivide multi, and set it to 8.

Now, we'll make this cloth by going to the Object context (F7) → Physics sub-context. Scroll down until you see the Cloth panel, and press the Cloth button. Now, a lot of settings will appear, most of which we'll ignore now.

That's all you need to do to set your cloth up for animating, but if you hit AltA, your lovely fabric will just drop very un-spectacularly. That's what we'll cover in the next two sections about pinning and colliding.

Using Simulation to Shape/Sculpt a Mesh

You can Apply the Cloth modifier at any point to freeze the mesh in position at that frame. You can then re-enable cloth, setting the start and end frames from which to run the simulation forward.

Another example of aging is a flag. Define the flag as a simple grid shape and pin the edge against the flagpole. Simulate for 50 frames or so, and the flag will drop to its "rest" position. Apply the Cloth modifier. If you want the flag to flap or otherwise move in the scene, re-enable it for the frame range when it is in camera view.

Smoothing of Cloth

Now, if you followed this from the previous section, your cloth is probably looking a little blocky. In order to make it look nice and smooth like the picture you need to apply a Smooth and/or Subsurf modifier in the Modifiers panel under the Editing context (F9). Then, in the same context, find the Links and Materials panel (the same one you used for vertex groups) and press Set Smooth.

Now, if you hit AltA, things are starting to look pretty nice, don't you think?

Cloth on armature

Cloth deformed by armature and also respecting an additional collision object: [Regression blend file](#).

Cloth with animated vertex groups

Cloth with animated pinned vertices: [Regression blend file](#). UNSUPPORTED: Starting with a goal of 0 and increasing it, but still having the vertex not pinned will not work (e.g. from goal = 0 to goal = 0.5).

Cloth with Dynamic Paint

Cloth with Dynamic Paint using animated vertex groups: [Regression blend file](#). UNSUPPORTED: Starting with a goal of 0 and increasing it, but still having the vertex not pinned will not work (e.g. from goal = 0 to goal = 0.5) because the necessary "goal springs" cannot be generated on the fly.

Using Cloth for Softbodies



☐ Using cloth for softbodies.

Cloth can also be used to simulate softbodies. It's for sure not it's main purpose but it works nonetheless. The example image uses standard Rubber material, no fancy settings, just AltA.

Blend file for the example image: [Using Cloth for softbodies](#).

Cloth with Wind



☐ Flag with wind applied.

Regression blend file for Cloth with wind and self collisions (also the blend for the image above): [Cloth flag with wind and selfcollisions](#).

Collisions

[Particles](#), [Soft Bodies](#) and [Cloth objects](#) may collide with mesh objects. [Boids](#) try to avoid Collision objects.

- The objects need to share at least one common layer to have effect.
- You may limit the effect on particles to a group of objects (in the [Field Weights panel](#)).
- *Deflection* for softbody objects is difficult, they often penetrate the colliding objects.
- Hair particles ignore deflecting objects (but you can animate them as softbodies which take deflection into account).

If you change the deflection settings for an object you have to recalculate the particle, softbody or cloth system (Free Cache), this is not done automatically. You can clear the cache for all selected objects with CtrlB → Free cache selected.

Mode: Object Mode

Panel: Object context → Physics sub-context → Collision

Options

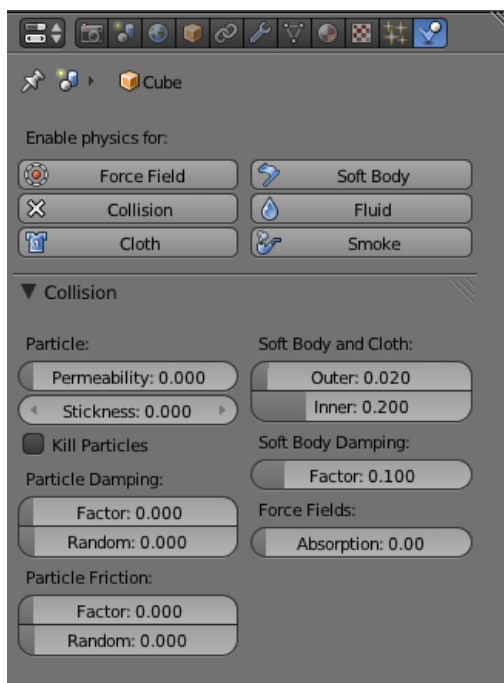


Image 1: Collision panel in the Physics sub-context.

Permeability

Fraction of particles passing through the mesh. Can be animated with Object lpos, Perm channel.

Stickiness

How much particles stick to the object.

Kill Particles

Deletes Particles upon impact.

Damping Factor

Damping during a collision (independent of the velocity of the particles).

Random damping

Random variation of damping.

Friction Factor

Friction during movements along the surface.

Random friction

Random variation of friction.

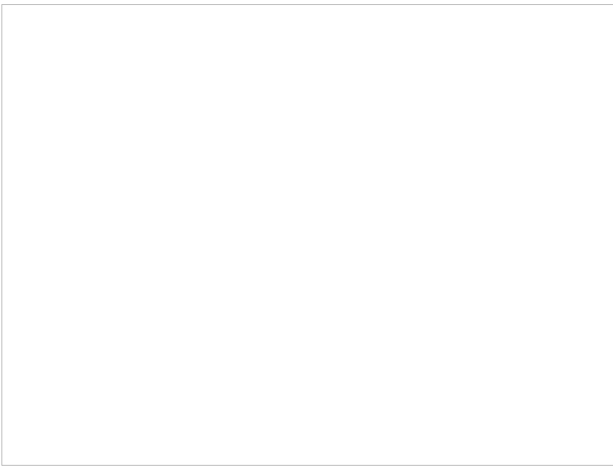


Image 1b: A softbody vertex colliding with a plane.

Soft Body and Cloth Interaction

Outer

Size of the outer collision zone.

Inner

Size of the inner collision zone (padding distance).

Outside and inside is defined by the face normal, depicted as blue arrow in (*Image 1b*).

Damping Factor

Damping during a collision.

Softbody collisions are difficult to get perfect. If one of the objects move too fast, the soft body will penetrate the mesh. See also the section about [Soft Bodies](#).

Force Field Interaction

Absorption

A deflector can also deflect effectors. You can specify some collision/deflector objects which deflect a specific portion of the effector force using the Absorption value. 100% absorption results in no force getting through the collision/deflector object at all. If you have 3 collision object behind each other with e.g. 10%, 43% and 3%, the absorption ends up at around 50% ($100 \times (1 - 0.1) \times (1 - 0.43) \times (1 - 0.03)$).

Examples



Image 2: Deflected Particles.

Here is a Meta object, duplivered to a particle system emitting downwards, and deflected by a mesh cube:

Hints

- Make sure that the normals of the mesh surface are facing towards the particles/points for correct deflection.
- Hair particles react directly to force fields, so if you use a force field with a short range you don't need necessarily collision.
- Hair particles avoid their emitting mesh if you edit them in Particle mode. So you can at least model the hair with collision.

Page status ([reviewing guidelines](#))

Partial page Text no explanation about options

Proposed fixes: none

Explode Modifier

Mode: Any Mode

Panel: Editing Context → Modifiers

Hotkey: None

Description

The Explode Modifier is used to alter the mesh geometry (by moving/rotating its faces) in a way that (roughly) tracks underlying emitted particles that makes it look as if the mesh is being exploded (broken apart and pushed outward).

For the Explode Modifier to have a visible effect on the underlying mesh it has to be applied to a mesh which has a particle system on it, in other words it has to be a mesh which outputs particles. This is because the particle system on the mesh is what controls how a mesh will be exploded, and therefore without the particle system the mesh wont appear to alter. Also both the number of emitted particles and number of faces determine how granular the Explode Modifier will be. With default settings the more faces and particles the more detailed the mesh exploding will be, because there are more faces and particles to affect detachment/movement of faces.

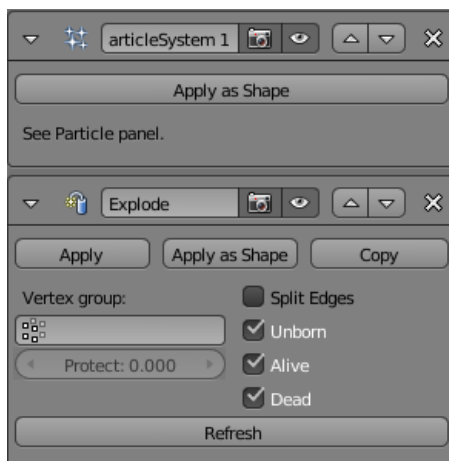
Here is a link to an Ogg Theora Movie showing a cube with a particle system and Explode Modifier applied:

[Media:Manual - Explode Modifier - Exploding Cube - 2.5.ogg](#)

Here is a link to the original Blender file which has an Exploding cube setup, just free the particle cache by pressing the Free Bake button in the bake panel and then press the Animate button to see the animation:

[Media:Manual - Explode Modifier - Exploding Cube - 2.5.blend](#)

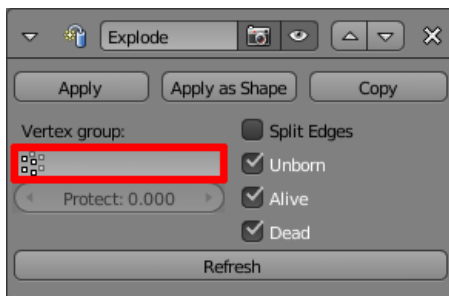
Options



Explode Modifier panel with Particle System Modifier above it

Stacking Order Importance

This modifier is highly affected by its position within the modifier stacking order. If it is applied before a Particle System modifier it will not be affected by particles and therefore appear to do nothing. The Particle System Modifier must appear before the Explode Modifier because the Particle System Modifier has the information needed to drive the Explode Modifier.



Explode Modifier panel with "Protect this vertex group" field highlighted in red

Protect this vertex group

If a mesh that has an Explode Modifier on it also has vertex groups assigned to it then this field will allow the selection of one of those vertex groups. This will indicate to the Explode Modifier that it should take into account the weight values assigned to areas of the selected vertex group. Then depending on the weights assigned to that vertex group; either completely protect those faces from being affected by the Explode Modifier (which would happen if the faces had a weight value of 1) or completely remove protection from those faces (which would happen if the faces had a weight value 0).

Fluid Simulation

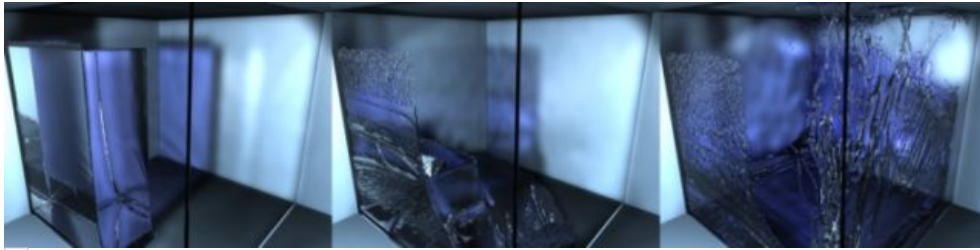
Mode: Object mode / Edit mode (Mesh)

Panel: Physics sub-context → Fluid

Description

While modeling a scene with blender, certain objects can be marked to participate in the fluid simulation, e.g. as fluid or as an obstacle. The bounding box of another object will be used to define a box-shaped region to simulate the fluid in (the so called “simulation domain”). The global simulation parameters (such as viscosity and gravity) can be set for this domain object.

Using the BAKE button, the geometry and settings are exported to the simulator and the fluid simulation is performed, generating a surface mesh together with a preview for each animation frame, and saving them to hard disk. Then the appropriate fluid surface for the current frame is loaded from disk and displayed or rendered.



A breaking dam.

Workflow

In general, you follow these steps:

- set the [simulation domain](#) (the portion of the scene where the fluid will flow),
- set the [fluid source\(s\)](#), and specify its material, viscosity, and initial velocity,
- eventually, set other [objects to control the volume](#) of the fluid (inlets and outlets),
- eventually, set other objects related to the fluid, like:
 - [obstacles](#),
 - [particles](#) floating on the fluid,
 - [fluid control](#), to shape part of the fluid in the desired form,
- eventually, [animate the fluid properties](#),
- [Bake the simulation](#) (eventually, revise as necessary and bake repeatedly).



Baking is done on the Domain object!

When you calculate the fluid simulation, **you bake the simulation on the domain object**.

For this reason:

- all the baking options are visible only when selecting the Domain Object,
- baking options are explained in the [the baking section](#) of the Domain manual page.

More about the simulation

To know more about simulating fluids in Blender you can read:

- some [useful hint](#) about the simulation,
- some [technical details](#), to learn how to do a more realistic fluid simulation,
- the [fluids appendix](#) to learn limitations and workarounds, and some additional links.

Ocean Simulation

Blender's ocean simulation tools take the form of a modifier, to simulate and generate a deforming ocean surface, and associated texture, used to render the simulation data. Ported from the open source Houdini Ocean Toolkit, it is intended to simulate deep ocean waves and foam.

Simulation Internals

The simulator itself uses FFT methods to generate 2d grids of sim information internally, very similar to 2d texture maps. The simulator can generate three types of data - displacement, normals, and extra data that is used to calculate wave crest intersections (i.e. foam). After simulation, these maps are used to displace the ocean surface geometry in 3d, and also can be used for shading via the Ocean texture. The internal simulation engine is multithreaded with OpenMP to take advantage of multiple cores.

Ocean Modifier

Mode: Object mode

Panel: Modifiers context

Description



Ocean Modifier Panel

The Ocean Modifier is the main place in Blender where the simulation is performed - the modifier stores the simulation data, and applies it to create a deformed ocean surface mesh. The ocean modifier can also add a vertex color channel, in order to visualize a foam map.

Geometry Options

Geometry

The ocean modifier can affect mesh geometry by:

- Generating a tiled mesh grid that exactly corresponds with the resolution of the sim data

When generating a mesh surface, the existing mesh object is completely overridden with the ocean grid. A UV channel is also added, mapping the [0.0,1.0] UV space to the simulation grid.


- Displacing an existing mesh of arbitrary topology

Repeat X, Repeat Y

When generating a mesh surface, controls the number of times the grid is tiled in X and Y directions. UVs for these tiled mesh areas continue outside of the [0,1] UV space.

Simulator Options

Time

The time at which the ocean surface is being evaluated. To make an animated ocean, you will need to insert keyframes (RMB ) and animate this time value - the speed that the time value is changing will determine the speed of the wave animation

Resolution

The main control of quality vs speed in the simulation engine, this determines the resolution of the internal 2D grids generated by the sim. The internal grids are powers of two of the resolution value, so a resolution value of 16 will create simulation data of size 256x256. The higher the resolution, the slower it will be to calculate, but the more detail will be available to use.

Note: When using the 'Generate' modifier geometry option, this resolution value also determines the resolution of the generated mesh surface, equal to the resolution of the internal sim data.

Spatial Size

The width of the ocean surface area being simulated, in meters. This also determines the size of the generated mesh, or the displaced area, in Blender units. Of course you can scale the object with ocean modifier in object mode to tweak the apparent size in your scene.

Depth

The constant depth of the ocean floor under the simulated area

Wave Options

Choppiness

The choppiness of the wave peaks. With a choppiness of 0, the ocean surface is only displaced up and down in the Z direction, but with higher choppiness, the waves are also displaced laterally in X and Y, to create sharper wave peaks.

Scale

An overall scale control for the amplitude of the waves. It approximates the height or depth of the waves above or below zero. Rather than just scaling the ocean object in Z, it scales all aspects of the simulation, displacement in X and Y, and corresponding foam and normals too.

Alignment

The directionality of the wave shapes due to wind. At a value of 0, the wind and waves are randomly, uniformly oriented. With higher Alignment values, the wind is blowing in a more constant direction, making the waves appear more compressed and aligned to a single direction.

Direction

When using Alignment, the direction in degrees that the waves are aligned to.

Damping

When using Alignment, amount that inter-reflected waves are damped out. This has the effect of making the wave motion more directional (not just the wave shape). With damping of 0.0, waves are reflected off each other every direction, with damping of 1.0, these inter-reflected waves are damped out, leaving only waves traveling in the direction of the wind.

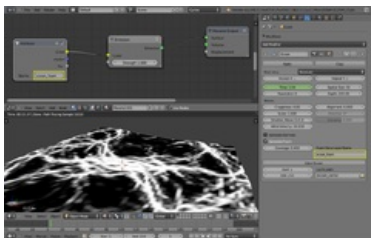
Smallest Wave

A minimum limit for the size of generated waves. Acts similarly to a low-pass filter, removing higher frequency wave detail.

Wind Velocity

Wind speed in meters/second. With a low velocity, waves are restricted to smaller surface waves.

Sim Data Generation Options



Using foam vertex colors with a named data layer

By default, the simulator only generates displacement data, since it takes the least amount of work and gives the fastest feedback. Additional sim data can be generated for rendering as well.

Generate Normals

Simulates additional normal map data. This can be used by the Ocean texture, when mapped to Normals, as a bump map, and enables generating normal map image sequences when baking.

Generate Foam

Simulates additional foam data. This can be retrieved by the Ocean texture for use in texturing (perhaps as a mask), and enables generating foam map image sequences when baking.

Coverage

Tweaks the amount of foam covering the waves, negative values will reduce the amount of foam (leaving only the topmost peaks), positive values will add it.

Foam Data Layer Name

Optional name for the vertex data layer, used by the Ocean modifier to store foam maps as vertex colors. This is required for accessing the foam data in the renderer.

Baking

Rather than simulating the ocean data live, the ocean data can be baked to disk. When a simulation is baked, the simulator engine is completely bypassed, and the modifier/texture retrieves all information from the baked files.

Baking can be advantageous for a few reasons:

- It's faster to use the stored data rather than re-calculating it
- Allows rendering ocean data in external renderers
- Enables more advanced foam maps

Data Files

Sim data is stored in disk as sequences of OpenEXR image maps, one for each of displacement, normal and foam (if enabled to be generated). Upon loading the data from these baked files, when a frame of the bake sequence is read from disk, it is cached in memory. This means that accessing loaded frames subsequent times is fast, not incurring the overhead of disk access.

Since these baked files are plain OpenEXRs, they can also be opened and rendered in any other application or renderer that supports them.

Baking Foam

Baking also provides improved foam capabilities. When simulating live, the ocean simulator retrieves data for that current frame only. In the case of the foam map, this represents the tips of wave crests for that given frame. In reality, after foam is created by wave interactions, it remains sitting on the top of the wave surface for a while, as it dissipates. With baking, it's possible to approximate that behaviour, by accumulating foam from previous frames, leaving it remaining on the surface.

Baking Options

Start, End

Frames of the simulation to bake (inclusive). The start and end frames of the bake are repeated when accessing frames outside the baked range.

Cache Path

Folder to store the baked EXR files in. The sequences will be in the form disp_####.exr, normal_####.exr, and foam_####.exr where #### is the four digit frame number. If the cache path folder does not exist, it will be created.

Simulated and baked to image maps in Blender, rendered in 3Delight.

History

The core simulator was developed by Drew Whitehouse, for the [Houdini Ocean Toolkit](#). This was ported to C by Hamed Zaghaghi and integrated in a patch for the Blender 2.4 series, sponsored by ProMotion Studios/[Red Cartel](#) during production of the short film Lighthouse.

In this work, Matt Ebb re-integrated the core simulator for Blender 2.5, and added additional functionality, fixes, and optimisations, sponsored by the '[Save the Ocean Sim](#)' project.

Text duplicate of [Doc:2.6/Manual/Modifiers/Objects/ParticleInstance?](#)

Proposed fixes: Delete one of the pages. Possibly update also.

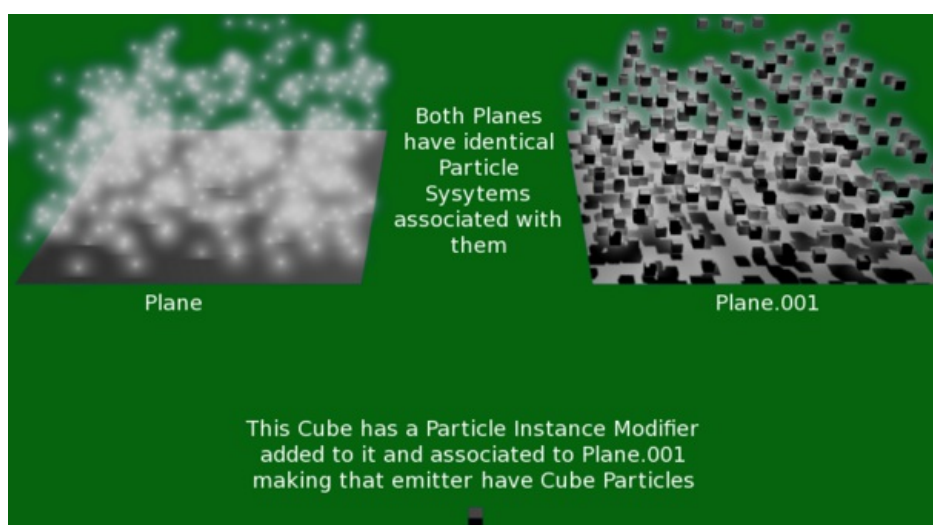
Particle Instance Modifier

Mode: Any mode

Panel: Modifiers (Editing context, F9)

Description

When a ParticleInstance modifier is added to an object, that object will be used as a particle shape on an object which has a particle system associated with it. This means that to use this modifier you must also have another object which has a particle system on it, otherwise the ParticleInstance modifier will appear to do nothing.



Particle system on left has no ParticleInstance modified object associated with it. The one on the right is associated with cube shown by using a ParticleInstance modifier on the cube.

Overview

Here is a brief explanation of the various terms and definition used in relation to particles and the ParticleInstance modifier:

- Particle system – An object (mesh) which has the ability to emit/generate particles activated on it.
- Normal particle – A particle that is not a children/child generated particle type.
- Children/child particle – A particle type that is generated and placed with relation to other normal particles that already exist. Children particles are generally much quicker to calculate.
- Unborn particle – A particle which has not yet been displayed/emitted because it is not its time to be emitted/displayed. One of the reasons a particle can be in unborn state is that it is before the frame at which it is to be emitted.
- Alive particle – A particle which has been displayed/emitted and has not yet reached its dead state. One of the reasons a particle can be in an alive state is that it has been alive for less frames than its life length.
- Dead particle – A particle which has been displayed/emitted and has reached its end of life length and at that point it enters the dead state.

Options

Because of the co-dependant way in which the ParticleInstance modifier is influenced by the underlying particle systems on other objects, some of the apparent effects generated by the ParticleInstance modifier can look and act vastly different, depending on the underlying settings of the particle systems it is associated with. This is worth taking account of if the ParticleInstance modifier settings don't appear to be giving the results expected, as it may indicate that the particle system settings may need altering rather than the ParticleInstance modifier settings.

Object

The Object field, associates this ParticleInstance modifier with another object (usually an object having a particle system...). This indicates that when the object named in this field emits particles, those particles will have the mesh shape of the current

ParticleInstance modifier's mesh.

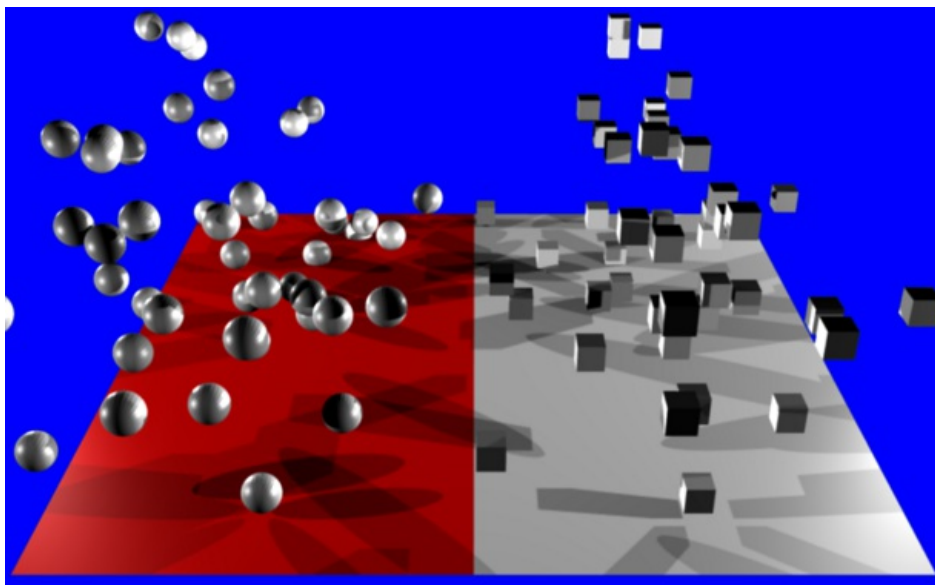
If for example a sphere has a ParticleInstance modifier added to it, when the Object field of this modifier is filled in with the name of an object that emits particles, those particle will be sphere shaped.

Even though most of the time the Object field will have the name of an object with a particle system, this is not mandatory, you can enter an object's name which does not have a particle system, and it will be accepted by the Object field, as there do not appear to be any checks made to make sure the object's name entered into this field is "valid".

Particle System

The Particle System field is used to select which particle system number to apply the ParticleInstance modifier to, when the mesh which has the particle system on it has more than one of these. The Particle System field can have a value between **1** and **10**. It is possible to select any of the ten particle system numbers, however a check will **not** be made with the underlying particle emitting object specified previously in the Object field. If you select a particle system number which does not exist on the particle emitting object, then the particles on the emitting mesh will keep their normal particle shapes – no warning will be given that the chosen particle system does not exist on a particular particle emitting mesh.

As an example, below is a single plane mesh with two areas (the first area shown in red and the second in white), with different particle systems applied to each area. The left side using a ParticleInstance modifier which has the shape of a sphere and the right side having a ParticleInstance modifier which has the shape of a cube.



Render showing a single Plain mesh object assigned to two different vertex groups and each of those vertex groups is assigned a separate and independent particle system, with each particle system being assigned a different ParticleInstance modifier. In the case shown the ParticleInstance modifiers are a sphere and a cube.

[Example Blend file](#)

Creation

Normal

When selected, the Normal button tells the ParticleInstance modifier to draw instances of itself wherever normal particle types are emitted from the underlying particle system. So if the current ParticleInstance modifier is a sphere shape, when normal particles are emitted they will be spheres.

Children

When selected, the Children button tells the ParticleInstance modifier to draw instances of itself wherever children/child particles are emitted/used on the underlying particle system. So if the current ParticleInstance modifier is a sphere shape, when children/child particles are emitted they will be spheres.

Size

Scale the instanced objects by the particle size attribute. When this is disabled, all the copies appear the same size as the origin.

Display

Unborn

When selected, the Unborn button tells the ParticleInstance modifier to draw instances of itself wherever unborn particles will be emitted/used on the underlying particle system. So if the current ParticleInstance modifier is a sphere shape, when unborn particles are present they will be spheres.

Alive

When selected, the Alive button tells the ParticleInstance modifier to draw instances of itself wherever alive particles will be emitted/used on the underlying particle system. So if the current ParticleInstance modifier is a sphere shape, when alive particles are present they will be spheres.

Dead

When selected, the Dead button tells the ParticleInstance modifier to draw instances of itself wherever dead particles will occur on the underlying particle system. So if the current ParticleInstance modifier is a sphere shape, when dead particles are present they will be spheres.

Using Paths

Create Along Paths

This option tries to make the underlying mesh object of the Particle Instance modifier deform its mesh shape in such a way as to try and match the path traveled by the particles/hair strands of the system associated with it.

For example, below is a screen shot showing the path of a single keyed particle as it travels its way through each of the different way points **1** to **4** (target particle systems), when it reaches way point **4** the particle dies and ends its journey.

X,Y,X Rotation Axis

Specify which pole axis to use for the rotation.

Keep Shape

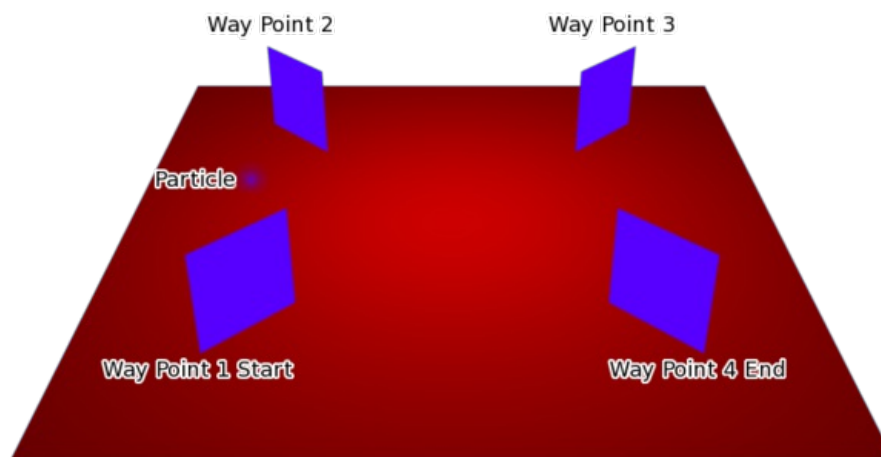
Enabling this prevents the object from being deformed. It instead simply aligns to the end of the path at the object's center.

Position

Specify what percentage of the path the object fills. You could create a growing effect by animating this value over time.

Random

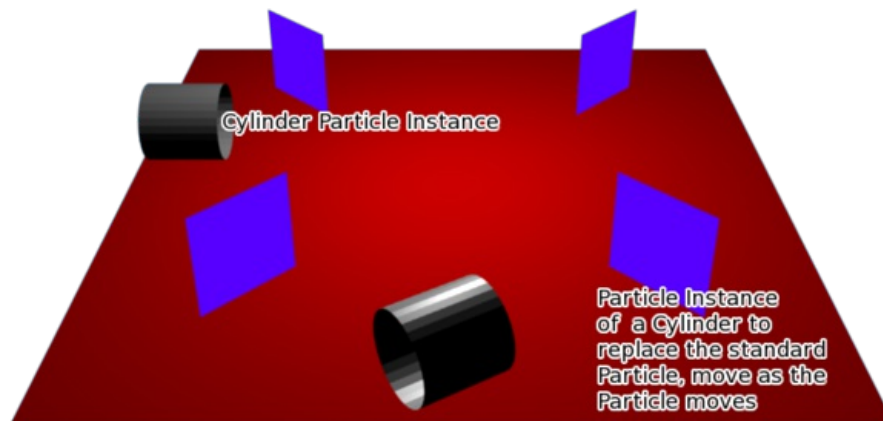
Scales the position value of each instance a random value.



Keyed particle following way points (showing one particle).

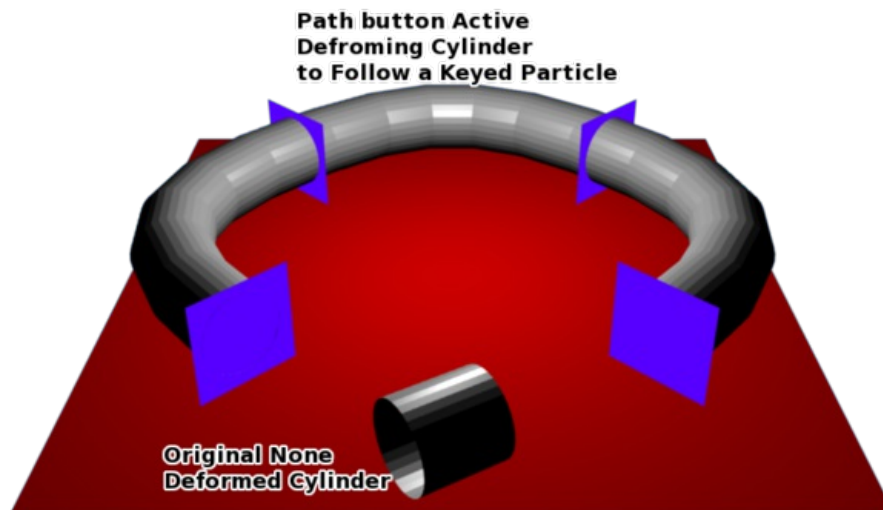
[Example Blend file](#)

When a ParticleInstance modifier is added to a cylinder object and then associated with the way point particle system, the particle position is copied by the cylinder and placed at the particles position. So the mesh object follows the location of the particle. The cylinder does not alter any of its other properties when following the particle, only the cylinders location gets altered, shape and rotation do not get altered. See screenshot below:



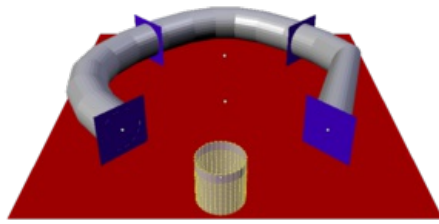
- ☐ Keyed particle following way points showing a mesh object (ParticleInstance modifier) in place of the original particle.
[Example Blend file](#)

Both of the above examples had the ParticleInstance modifier Path button deactivated. When the Path button is activated the effect can be seen in the screenshot below:

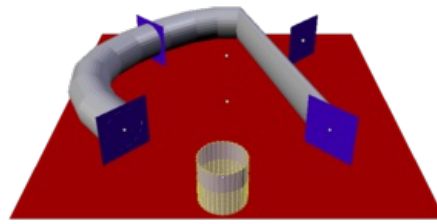


- ☐ Keyed particle following way points showing a mesh object (ParticleInstance modifier) in place of the original particle, that is also being deformed to fit the travel path of the original particle.
[Example Blend file](#)

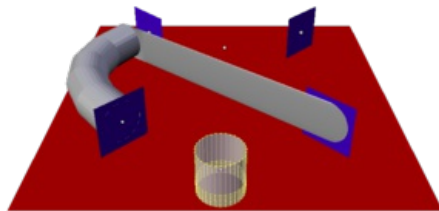
Instead of the cylinder location just following the position of the particle (and not altering its shape), the cylinder tries to fit its mesh to the shape of the path followed by the particle. The mesh geometry of the object which is trying to deform can have an impact on how well the deformation is carried out. In the case of the cylinder, it has many loop cuts along its length so that it can bend at those points to deform along the particle path. For example here is the same scene with the number of loop cuts along the length of the cylinder reduced, showing the effect on the deformation of the cylinder along the particle path.



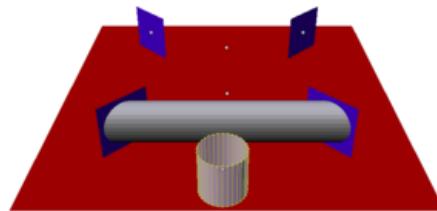
☐ The cylinder has most of its edge loops so most of the path deform is very regular apart from at the very end of the curve.



☐ The cylinder has some of its edge loops removed so the path of the deform starts to become less regular.



☐ Now the deform path is very rough.

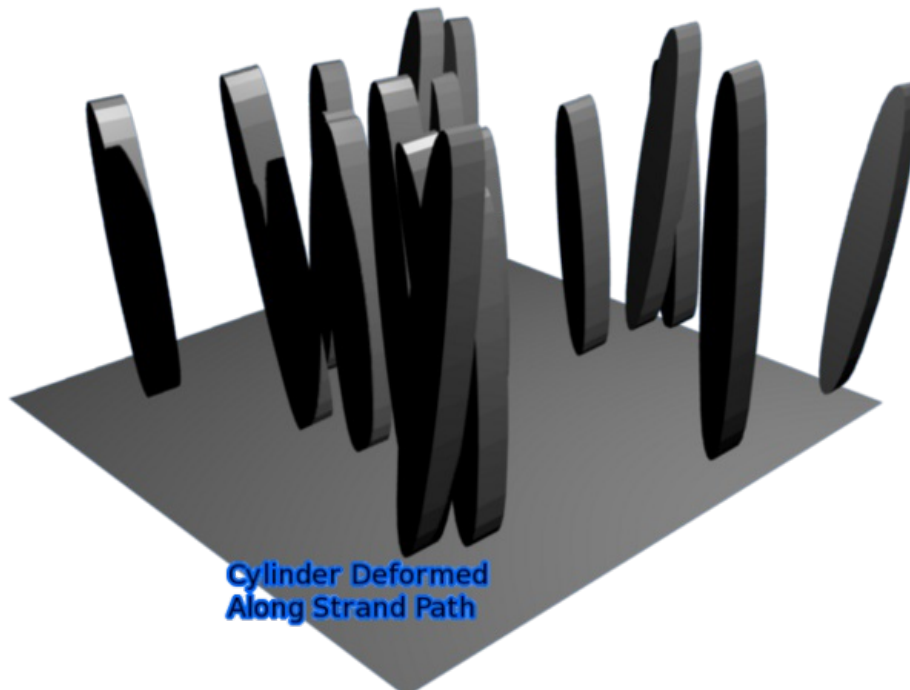


☐ At this point there aren't any vertices to bend the cylinder to follow the path, and instead the cylinder just goes directly to the last way point **4**.

Once all the extra edge loops around cylinder are removed so that there is only the top and bottom vertices left, meaning that the cylinder doesn't have enough geometry to bend, in that case it cannot follow the path of the particle, so it just goes from the start way point **1** to the ending way point **4**.

The ParticleInstance modifier Path button works for hair (strand) particles as well as with keyed particles. In this case the mesh of the ParticleInstance modifier will follow the length and profile of the hair strands paths.

Below is a screenshot showing the effect of the Path button on hair:



☐ Strand with a ParticleInstance modifier associated with it and deforming the cylinder along the hair profile.
[Example Blend file](#)

Note
 Strands when they are generated instantly die when created so for the Path button to be of any use, you must also have the Dead button activated. Otherwise the path a mesh took will not be visible!

See Also

- [Particles](#)

Particles

Particles are lots of items emitted from mesh objects, typically in the thousands. Each particle can be a point of light or a mesh, and be joined or dynamic. They may react to many different influences and forces, and have the notion of a lifespan. Dynamic particles can represent fire, smoke, mist, and other things such as dust or magic spells.

[Hair](#) type particles are a subset of regular particles. Hair systems form strands that can represent hair, fur, grass and bristles.

You see particles as a Particle modifier, but all settings are done in the Particle sub-context of the Object context.

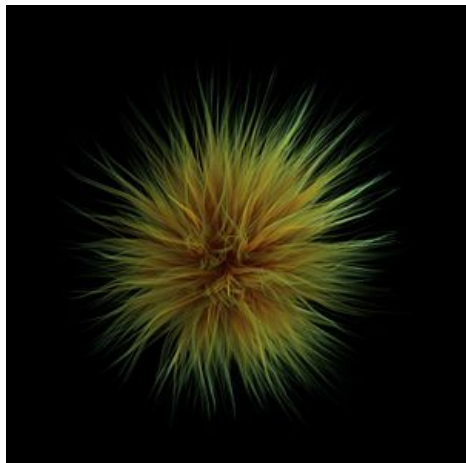


Image 1: Some fur made from particles
([Blend file](#)).

Particles generally flow out from their mesh into space. Their movement can be affected by many things, including:

- Initial velocity out from the mesh.
- Movement of the emitter (vertex, face or object) itself.
- Movement according to “gravity” or “air resistance”.
- Influence of force fields like wind, vortexes or guided along a curve.
- Interaction with other objects like collisions.
- Partially intelligent members of a flock (herd, school, ...), that react to other members of their flock, while trying to reach a target or avoid predators.
- Smooth motion with softbody physics (only Hair particle systems).
- Or even manual transformation with [Lattices](#).

Particles may be rendered as:

- [Halos](#) (for Flames, Smoke, Clouds).
- Meshes which in turn may be animated (e.g. fish, bees, ...). In these cases, each particle “carries” another object.
- [Strands](#) (for [Hair](#), [Fur](#), [Grass](#)); the complete way of a particle will be shown as a strand. These strands can be manipulated in the 3D window (combing, adding, cutting, moving, etc).

Every object may carry many particle systems. Each particle system may contain up to 100.000 particles. Certain particle types (Hair and Keyed) may have up to 10.000 children for each particle (children move and emit more or less like their respective parents). The size of your memory and your patience are your practical boundaries.

Incompatibility with Prior Versions

There are many differences between the “old” particle system that was used up to and including version 2.45, and the “new” particle system. There are many things possible now that could not be done with the old system. The new system is incompatible to the old system, though Blender tries to convert old particle systems, which works only to some extent. The old system is most like the new Emitter system (keep reading to find out what that is). If you are using an old version of Blender 2.45 and previous, [click here to access the old documentation](#).

Workflow

The process for working with standard particles is:

1. Create the mesh which will emit the particles.
2. Create one or more Particle Systems to emit from the mesh. Many times, multiple particle systems interact or merge with each other to achieve the overall desired effect.
3. Tailor each Particle System’s settings to achieve the desired effect.

4. Animate the base mesh and other particle meshes involved in the scene.
5. Define and shape the path and flow of the particles.
6. For [Hair](#) particle systems: Sculpt the emitter's flow (cut the hair to length and comb it for example).
7. Make final render and do physics simulation(s), and tweak as needed.

Creating a Particle System

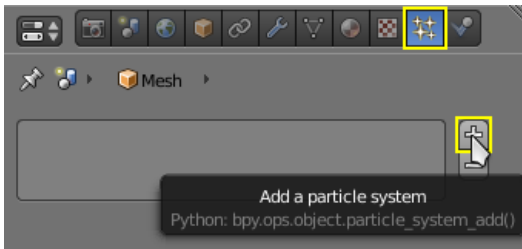


Image 2: Adding a particle system.

To add a new particle system to an object, go to the Particles tab of the object Settings editor and click the small + button. An object can have many Particle Systems.

Each particle system has separate settings attached to it. These settings can be shared among different particle systems, so one doesn't have to copy every setting manually and can use the same effect on multiple objects. Using the Random property they can be randomized to look slightly different, even when using the same settings.

Types of Particle systems

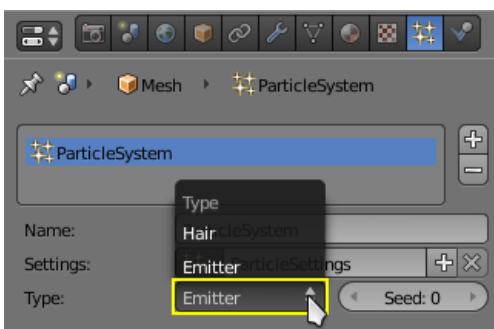


Image 3: Particle system types.

After you have created a particle system, the Property window fills with many panels and buttons. But don't panic! There are two different types of particle systems, and you can change between these two with the Type drop-down list:

Emitter

This parallels the old system to the greatest extent. In such a system, particles are emitted from the selected object from the Start frame to the End frame and have a certain lifespan.

[Hair](#)

This system type is rendered as strands and has some very special properties: it may be edited in the 3D window in realtime and you can also animate the strands with [Cloth Simulation](#).

The settings in the Particle System panel are partially different for each system type. For example, in *Image 3* they are shown for only system type Emitter.

Common Options

Each system has the same basic sets of controls, but options within those sets vary based on the system employed. These sets of controls are:

Emission	Settings for the initial distribution of particles on the emitter and the way they are born into the scene.
Cache	In order to increase realtime response and avoid unnecessary recalculation of particles, the particle data can be cached in memory or stored on disk.
Velocity	Initial speed of particles.
Rotation	Rotational behavior of particles.
Physics	How the movement of the particles behaves.
Render	Rendering options.
Display	Realtime display in the 3D View.

Children	Control the creation of additional child particles.
Field Weights	Factors for external forces.
Force Field Settings	Makes particles force fields.
Vertex Groups	Influencing various settings with vertex groups.

Links

- [Tutorials](#)
- [Physics Caching and Baking](#)
- [Particle Rewrite Documentation](#)
- [Thoughts about the particle rewrite code](#)
- [Static Particle Fur Library](#)

Smoke Simulation

Development notes

Blender's new smoke simulation is based on the paper '[Wavelet Turbulence for Fluid Simulation](#)' and associated sample code.

It has been implemented in Blender by Daniel Genrich and Miika Hamalainen.

Inner working

The simulator uses a volumetric fluid-based model, with the end results output as voxel grids. This voxel data is visualized interactively in Blender's 3D view using custom OpenGL shading, and can be rendered using the Voxel Data texture. Blender's **smoke simulation** wraps Voxels around existing [Particles](#). It requires a particle-emitting object and a 'domain' object within which smoke is rendered.

Note

This Part of the Documentation uses the 2.58 Release

User workflow

The smoke simulation is similar to the Fluid simulation: a Domain and Flow object is required to do a smoke simulation:

- set as the simulation [Domain](#) an object that defines the bounds of the simulation volume,
- set as the [Flow object](#) an object which determines where the smoke will be produced from,
- set [Collision objects](#), to make the smoke interact with objects in the scene.
- assign a [Material](#) to the smoke
- [bake](#) the simulation

In case you are having troubles, please consult the [Appendix](#)

Soft Bodies



☐ Image 1a: A softbody cloth uncovering a text. [Animation](#) – [Blend file](#)

A Soft Body in general, is a simulation of a soft or rigid deformable object. In Blender, this system is best for simple cloth objects and closed meshes. There is dedicated [Cloth Simulation](#) physics that use a different solver, and is better for cloth.

This simulation is done by applying forces to the vertices or controlpoints of the object. There are exterior forces like gravity or forcefields and interior forces that hold the vertices together. This way you can simulate the shapes that an object would take on in reality if it had volume, was filled with something, and was acted on by real forces.

Soft Bodies can interact with other objects (*Collision*). They can interact with themselves (*Self Collision*).

The result of the Soft Body simulation can be converted to a static object. You can also *bake edit* the simulation, i.e. edit intermediate results and run the simulation from there.

Typical scenarios for using Soft Bodies



☐ Image 1b: A wind cone. The cone is a Soft Body, as the suspension. [Animation](#) – [Blend file](#)

Soft Bodies are well suited for:

- Elastic objects with or without collision.
- Flags, fabric reacting to forces.
- Certain modeling tasks, like a cushion or a table cloth over an object.
- Blender has another simulation system for clothing (see [Clothes](#)). But you can sometimes use Soft Bodies for certain parts of clothing, like wide sleeves.
- Hair (as long as you minimize collision).
- Animation of swinging ropes, chains and the like.

The following videos may give you some more ideas: [\[1\]](#), [\[2\]](#)

Creating a Soft Body

Soft Body simulation works for all objects that have vertices or control points:

- Meshes.
- Curves.

- Surfaces.
- Lattices.

To activate the Soft Body simulation for an object:

- In the Properties window, go to the Physics tab (it is all the way on the right, and looks like a bouncing ball).
- Activate the Soft Body button.

A lot of options appear. For a reference of all the settings see [this page](#).

- You start a Soft Body simulation with AltA.
- You pause the simulation with Space, continue with AltA.
- You stop the simulation with Esc.

Simulation Quality

The settings in the Soft Body Solver panel determine the accuracy of the simulation.

Min Step

Minimum simulation steps per frame. Increase this value, if the Soft Body misses fast moving collision objects.

Max Step

Maximum simulation steps per frame. Normally the number of simulation steps is set dynamically (with the Error Limit) but you have probably a good reason to change it.

Auto-Step

Use Velocities for automatic step sizes.

Error Limit

Rules the overall quality of the solution delivered. Default 0.1. The most critical setting that says how precise the solver should check for collisions. Start with a value that is 1/2 the average edge length. If there are visible errors, jitter, or over-exaggerated responses, decrease the value. The solver keeps track of how “bad” it is doing and the Error Limit causes the solver to do some “adaptive step sizing”.

Fuzzy

Simulation is faster, but less accurate.

Choke

Calms down (reduces the exit velocity of) a vertex or edge once it penetrates a collision mesh.

Diagnostics

Print Performance to Console

Prints on the console how the solver is doing.

Estimate Matrix

Estimate matrix. Split to COM , ROT ,SCALE

Cache and Bake

Soft Bodies and other physic simulations use a unified system for caching and baking. See [Particle Cache](#) for reference.

The results of the simulation are automatically cached to disk when the animation is played, so that the next time it runs, it can play again quickly by reading in the results from the disk. If you Bake the simulation the cache is protected and you will be asked when you're trying to change a setting that will make a recalculating necessary.



Beware of the Start and End settings

The simulation is only calculated for the frames in-between the Start and End frames (Bake panel), even if you don't actually bake the simulation! So if you want a simulation longer than the default setting of 250 frames you have to change the End frame.

- Caching:
 - As animation is played, each physics system writes each frame to disk, between the simulation start and end frames. These files are stored in folders with prefix “blendcache”, next to the .blend file.
 - The cache is cleared automatically on changes - but not on all changes, so it may be necessary to free it manually, e.g. if you change a force field. Note that for the cache to fill up, one has to start playback before or on the frame that the

simulation starts.

- If you are not allowed to write to the required sub-directory caching will not take place.
- The cache can be freed per physics system with a button in the panels, or with the CtrlB shortcut key to free it for all selected objects.
- You may run into trouble if your .blend file path is very long and your operating system has a limit on the path length that is supported.
- Baking:
 - The system is protected against changes after baking.
 - The Bake result is cleared also with CtrlB for all selected objects or click on Free Bake for the current Soft Body system.
 - If the mesh changes the simulation is not calculated anew.

For renderfarms, it is best to bake all the physics systems, and then copy the blendcache to the renderfarm as well.

Interaction in real time

To work with a Soft Body simulation you will find it handy to use the Timeline window. You can change between frames and the simulation will always be shown in the actual state. The option Continue Physics in the Playback menu of the Timeline window lets you interact in real time with the simulation, e.g. by moving collision objects or shake a Soft Body object. And this is real fun!



Continue Physics does not work while playing the animation with AltA

Right. This works only if you start the animation with the Play button of the Timeline window.

You can then select the Soft Body object while running the simulation and Apply the modifier in the Modifiers panel of the Editing context. This makes the deformation permanent.

Tips

- Soft Bodies work especially well if the objects have an even vertex distribution. You need enough vertices for good collisions. You change the deformation (the stiffness) if you add more vertices in a certain region (see the animation of *Image 1b*).
- The calculation of collisions may take a long time. If something is not visible, why calculate it?
- To speed up the collision calculation it is often useful to collide with an additional, simpler, invisible, somewhat larger object (see the example to *Image 1a*).
- Use Soft Bodies only where it makes sense. If you try to cover a body mesh with a tight piece of cloth and animate solely with Soft Body, you will have no success. Self collision of Soft Body hair may be activated, but that is a path that you have to wander alone. We will deal with [Collisions](#) in detail later.
- Try and use a Lattice or a Curve Guide Soft Body instead of the object itself. This may be magnitudes faster.

Links

- [Developer Notes](#)
- [Swinging of a chain](#)
- [Softbodies for Rigged Characters](#)

Introduction

Lighting is a very important topic in rendering, standing equal to modeling, materials and textures. The most accurately modeled and textured scene will yield poor results without a proper lighting scheme, while a simple model can become very realistic if skillfully lit. Lighting, sadly, is often overlooked by the inexperienced artist who commonly believes that, since real world scenes are often lit by a single light (a lamp, the sun, etc.) a single light will also do in computer graphics. This is false because in the real world even if a single light source is present, the light shed by such a source bounces off objects and is re-irradiated all over the scene, making shadows soft and shadowed regions not pitch black, but partially lit.

Viewing Restrictions

The color of an object and the lighting of your scene is affected by:

- Your ability to see different colors (partial color blindness is common).
- The medium in which you are viewing the image (e.g. an LCD panel versus printed glossy paper).
- The quality of the image (e.g. a JPEG at **0.4** compression versus **1.0**).
- The environment in which you are viewing the image (e.g. a CRT monitor with glare versus in a dark room, or in a sunshiny blue room).
- Your brain's [perception](#) of the color and intensity relative to those objects around it and the world background color.

So, the exact same image viewed by person A on monitor B in room C may look very different to person D viewing a printout E of the image while on the subway F.

Global Influences

In Blender, the things under your control that affect lighting are:

- The color of the world [ambient light](#).
- The use of [Ambient Occlusion](#) as a way to cast that ambient light onto the object.
- The degree to which the ambient light colors the [material](#) of the object.
- The use of [indirect lighting](#), where the color of one object radiates onto another.
- The render engine used (Blender Internal versus [Yafray](#)).
- The [lamps](#) in your scene.

The physics of light bouncing around in the real-world is simulated by Ambient Occlusion (a world setting), buffer shadows (which approximate shadows being cast by objects), ray tracing (which traces the path of photons from a light source). Also, within Blender you can use [indirect lighting](#). Ray tracing, ambient occlusion, and indirect lighting are computer-intensive processes. Blender can perform much faster rendering with its internal scan line renderer, which is a very good scan line renderer indeed. This kind of rendering engine is much faster since it does not try to simulate the real behavior of light, assuming many simplifying hypotheses.

Lighting Settings

Only after the above global influences do you get into adding on light from lamps in your scene. The main things under your control are the:

- Type of light used (Sun, Spot, Lamp, Hemi, etc).
- Color of the light.
- Position of the light and its direction.
- Settings for each of those lights, including energy and falloff.

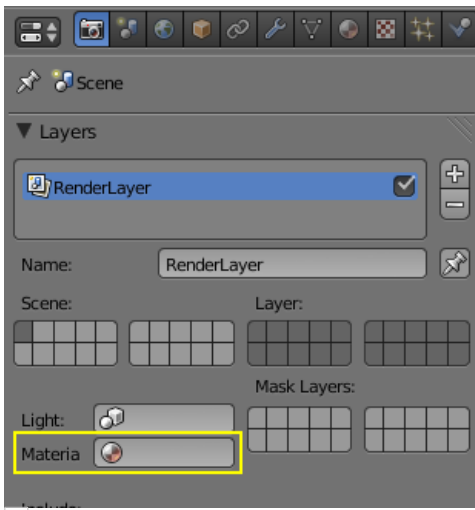
Then you are back to how that material's [shader](#) reacts to the light.

This chapter attempts to address the above, including how lights can work together in rigs to light your scene. In this chapter we will analyze the different type of lights in Blender and their behavior, we will analyze their strong and weak points. We also describe many lighting rigs, including the ever-popular three point light method.

Lighting in the Workflow

In this user manual we have placed Lighting before Materials; you should set up your lighting before assigning materials to your meshes. Since the material shaders react to light, without proper lighting, the material shaders will not look right, and you will end up fighting the shader, when it is really the bad lighting that is causing you grief. All of the example images in this section do not use any material setting at all on the ball, cube or background.

Over-riding Materials to Reset Lighting



Material field in the Render Layers panel

If you have started down the road of assigning materials, and are just now fiddling with the lighting, we suggest that you create a default, generic grey material; no Vertex Color, no Face Texture, no Shadeless, just plain old middle grey with an RGB of **(0.8, 0.8, 0.8)**.

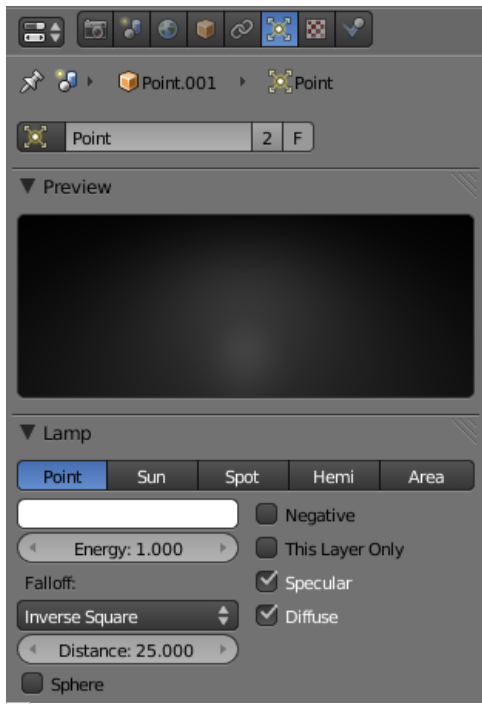
Next go to Render menu. In the Render Layers panel, select “Grey” in the Material field. This will override any materials you may have set, and render everything with this flat boring color. Using this material, you can now go about adjusting the lighting. Just empty this field to get back to your original materials.

Page status ([reviewing guidelines](#))

Partial page Text not all the option are common

Proposed fixes: none

Lights Common Options



Lamp Properties panels

There are five types of lamps in Blender. They share all or some of the options listed here:

Object Data

Browse Light Object Data

Click to view all lights in the current scene.

Name

The name of the currently selected light object data. Edit to change the name.

Number of Users

The number of light objects sharing the light object data.

F

Create a fake user for this object data.

Preview

A quick preview of the light settings.

Lamp

Distance

The Dist field indicates the number of Blender Units (BU) at which the intensity of the current light source will be half of its intensity. Objects less than the number of BU away from the lamp will get more light, while objects further away will receive less light. Certain settings and lamp falloff types affect how the Distance field is interpreted, meaning that it will not always react the same, see the page about [light falloff](#).

Energy

The intensity of the light sources illumination (from **0.0** to **10.0**).

Color

The color of the light sources illumination. Opens a color swatch.

Negative

Let the lamp cast negative light.

This Layer Only

Lamp only illuminates objects on the same layer as the lamp is on.

Specular

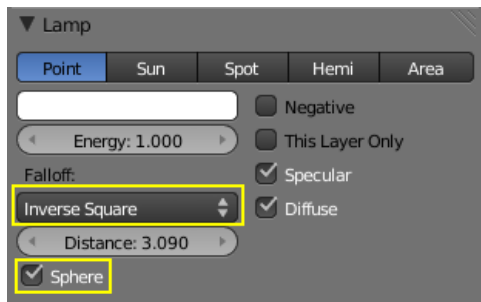
Lamp creates specular highlights.

Diffuse

Lamp does diffuse shading.

Light Attenuation

Description



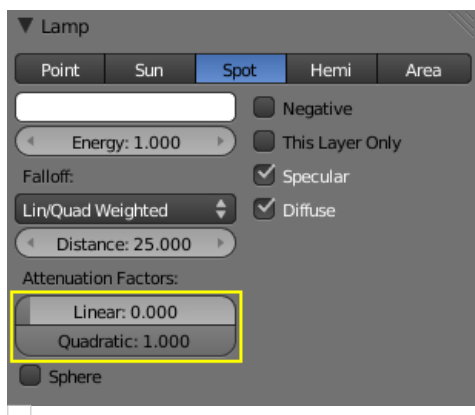
Lamp panel, falloff options highlighted

There are two main controls for the light falloff for the Lamp and Spot lamps.

- The lamp Falloff types drop-down list
- The Sphere button

Falloff types

Lin/Quad Weighted



Lamp panel with Lin/Quad Weighted Falloff options highlighted

When this setting is chosen, two sliders are shown, Linear and Quadratic which control respectively the “linearness” and “quadraticness” of the falloff curve.

This lamp falloff type is in effect allowing the mixing of the two light attenuation profiles (linear and quadratic attenuation types).

Linear

This slider input field can have a value between **0.0** and **1.0**. A value of **1.0** in the Linear field and **0.0** in the Quadratic field, in effect means that the light from this source is completely linear. Meaning that by the number of Blender Units distance specified in the Distance field, this light sources intensity will be half the value it was when it reaches the number of Blender Units distance specified in the Distance field.

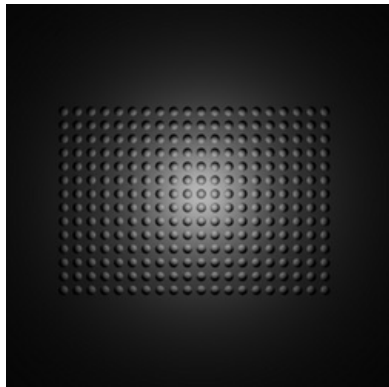
When the Quadratic slider is set to **0.0**, the formula for working out the attenuation at a particular range for full linear attenuation is:

$$I = E \times (D / (D + L \times r))$$

Where

- I is the calculated Intensity of light.
- E is the current Energy slider setting.
- D is the current setting of the Dist field.
- L is the current setting of the Linear slider.
- r is the distance from the lamp where the light intensity gets measured.

Quadratic



☐ Lamp with Lin/Quad Weighted falloff default settings

This slider input field can have a value between **0.0** and **1.0**. A value of **1.0** in the Quadratic field and **0.0** in the Linear field means that the light from this source is completely quadratic.

Quadratic attenuation type lighting is considered a more accurate representation of how light attenuates (in real world). In fact, fully quadratic attenuation is selected by default on Lin/Quad Weighted lamp fallout (see *Lamp with Lin/Quad Weighted falloff default settings*).

Here again, the light intensity is half when it reaches the Distance value from the lamp. Comparing the quadratic falloff to the linear falloff, the intensity decays much slowly at distances lower than the set Distance, but it attenuates much quicker after Distance is reached.

When the Linear slider is set to **0.0**, the formula for working out the attenuation at a particular range for full quadratic attenuation is:

$$I = E \times (D^2 / (D^2 + Q \times r^2))$$

Where

- I is the calculated Intensity of light.
- E is the current Energy slider setting.
- D is the current setting of the Dist field.
- Q is the current setting of the Quad slider.
- r is the distance from the lamp where the light intensity gets measured.

Mixing “Linear” and “Quad”

If both the Linear and Quad slider fields have values greater than **0.0**, then the formula used to calculate the light attenuation profile changes to this:

$$I = E \times (D / (D + L \times r)) \times (D^2 / (D^2 + Q \times r^2))$$

Where

- I is the calculated Intensity of light.
- E is the current Energy slider setting.
- D is the current setting of the Dist field.
- L is the current setting of the Linear slider.
- Q is the current setting of the Quad slider.
- r is the distance from the lamp where the light intensity gets measured.

Zeroing both “Linear” and “Quad”

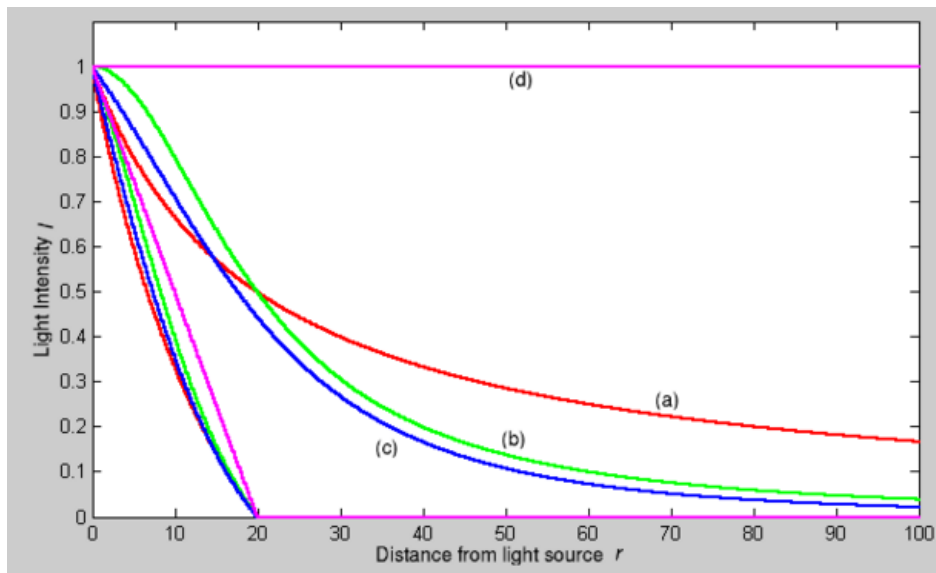
If both the Linear and Quadratic sliders have **0.0** as their values, the light intensity will not attenuate with distance. This does not mean that the light will not get darker, it will, but only because the energy the light has is spread out over a wider and wider distance. The total amount of energy in the spread out light will remain the same though. Light angle also affects the amount of light you see. It is in fact the behavior of light in the deep space vacuum.

If what you want is a light source that doesn't attenuate and gives the same amount of light intensity to each area it hits, you need a light with properties like the Constant lamp Falloff type.

Also, when the Linear and Quad sliders are both **0.0** values the Distance field ceases to have any influence on the light attenuation, as shown by the equation above.

Graphical Summary

Below is a graph summarizing the lin/quad attenuation type, showing attenuation with or without the Sphere option (described later).



Light Attenuation:

- a) Linear (Linear=1.0, Quad=0.0); b) Quadratic (Linear=0.0, Quad=1.0);
c) Linear and quadratic (Linear=Quad=0.5); d) Null (Linear=Quad=0.0).

Also shown in the graph the “same” curves, in the same colours, but with the Sphere button turned on.

Custom Curve

The Custom Curve lamp Falloff type is very flexible.

Most other lamp falloff types work by having their light intensity start at its maximum (when nearest to the light source) and then with some predetermined pattern decrease their light intensity when the distance from the light source gets further away.

When using the Custom Curve Lamp Falloff type, a new panel is created called Falloff Curve. This Falloff Curve profile graph, allows the user to alter how light intense light is at a particular point along a light’s attenuation profile (i.e. at a specific distance from the light source).


The Falloff Curve profile graph has two axes, the “Distance” axis and the “Intensity” axis.

Distance axis

It represents the position at a particular point along a light sources attenuation path. The far left being at the the position of the light source and the far right being the place where the light sources influence would normally be completely attenuated. I say “normally would” because the Falloff Curve can be altered to do the exact opposite if required.

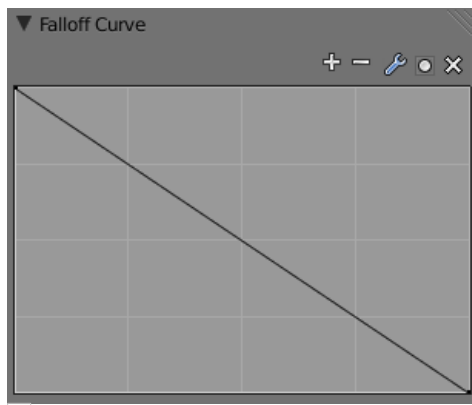
Intensity axis

It represents the intensity at a particular point along a light sources attenuation path. Higher intensity is represented by being higher up the intensity axis, while lower intensity light is represented by being lower down on the intensity axis.

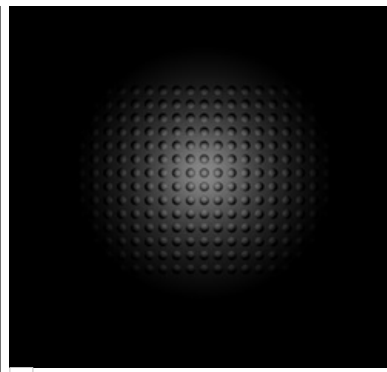
Altering the Falloff Curve profile graph is easy. Just LMB  click on a part of the graph you want to alter and drag it where you want it to be. If when you click you are over or near one of the tiny black square handles, it will turn white indicating that this is the handle that is now selected, and you will be able to drag it to a new position. If when you click on the graph you are not near a handle, one will be created at the point that you clicked, which you can then drag where you wish.

In the example below (the default for the Falloff Curve Profile Graph), the graph shows that the intensity of the light starts off at its maximum (when near the light), and linearly attenuates as it moves to the right (further away from the light source).



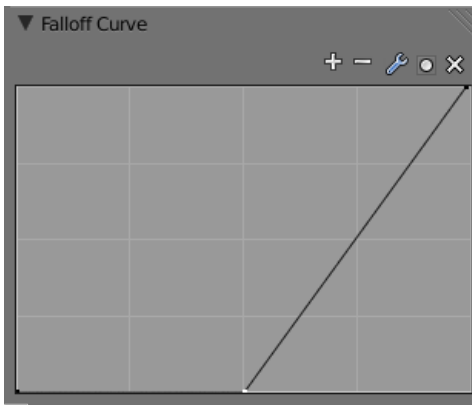


Default Falloff Curve panel graph.

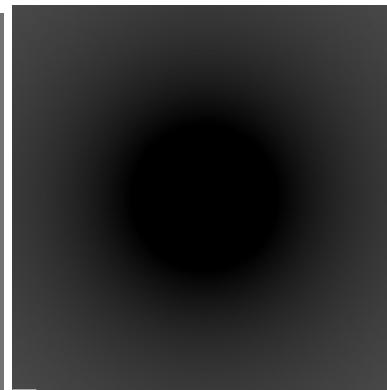


Render showing the Custom Curve lamp falloff type effect with default settings.

If you wanted to have a light attenuation profile that got more intense as it moved away from the light source, you could alter the graph as below:



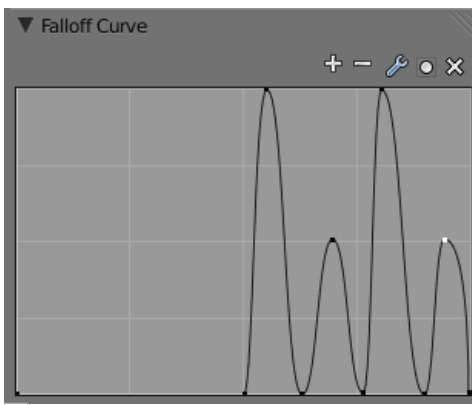
Falloff Curve for reversed attenuation.



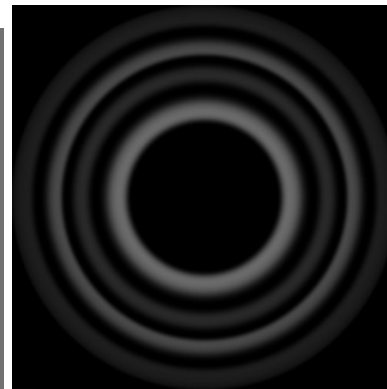
Falloff Curve for reversed attenuation rendered.

You are obviously not just limited to simple changes such as light reversing the attenuation profile, you can have almost any profile you desire.

Here is another example of different Falloff Curve profile graph, along with its resultant render output:

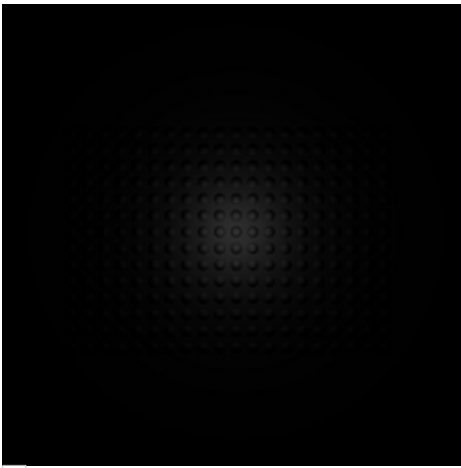


Oscillating attenuation profile.



Render showing the effects of a "wavelet" profile graph on the light attenuation.

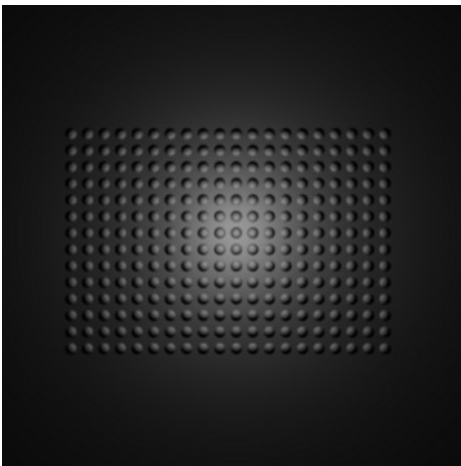
Inverse Square



☐ Render showing the Inverse Square lamp falloff type effect with default settings.

This lamp fallout type attenuates its intensity according to inverse square law, scaled by the Distance value. Inverse square is a sharper, realistic decay, useful for lighting such as desk lamps and street lights. This is similar to the old Quad option (and consequently, to the new Lin/Quad Weighted option with Linear to **0.0** and Quad to **1.0**), with slight changes.

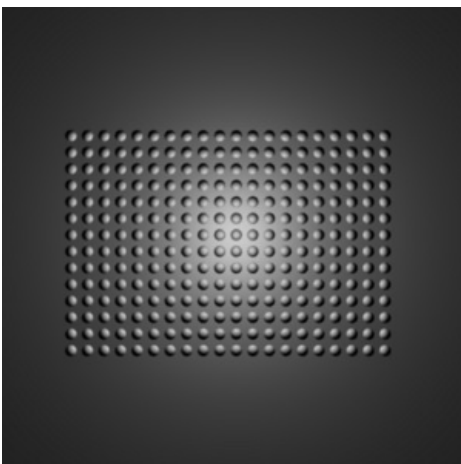
Inverse Linear



☐ Render showing the Inverse Linear lamp falloff type effect with default settings.

This lamp fallout type attenuates its intensity linearly, scaled by the Dist value. This is the default setting, behaving the same as the default in previous Blender versions without Quad switched on, and consequently, as the new Lin/Quad Weighted option with Linear to **1.0** and Quad to **0.0**. This isn't physically accurate, but can be easier to light with.

Constant

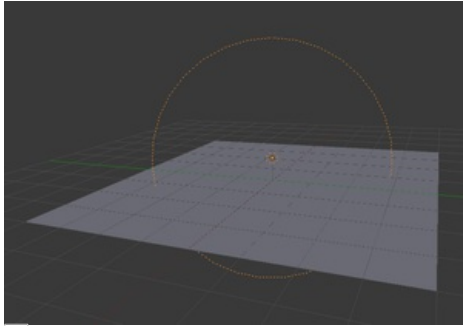


☐ Render showing the Constant lamp falloff type effect with default settings.

This lamp fallout type does not attenuate its intensity with distance. This is useful for distant light sources like the sun or sky, which are

so far away that their falloff isn't noticeable. Sun and Hemi lamps always have constant falloff.

Sphere



Screenshot of the 3D view window, showing the Sphere light clipping circle.

The Sphere option restricts the light illumination range of a Lamp or Spot lamp, so that it will completely stop illuminating past an area once it reaches the number of Blender Units away from itself, as specified in the Dist field.

When the Sphere option is active, a dotted sphere will appear around the light source, indicating the demarcation point at which this light intensity will be null.

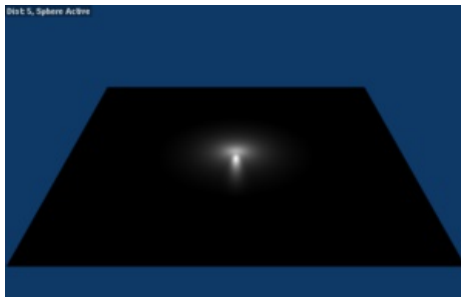
The Sphere option adds a term to the chosen attenuation law, whatever it is:

$$I' = I \times (D - r) / D \text{ if } r < D; 0 \text{ otherwise}$$

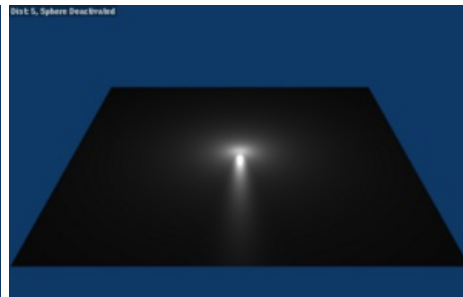
Where:

- I' is the required Intensity of light (with the Sphere option activated).
- I is the intensity of light calculated by the chosen attenuation law (without the Sphere option).
- D is the current setting of the Dist field.
- r is the distance from the lamp where the light intensity gets measured.

See the graphic at the end of the description of the Lin/Quad Weighted attenuation option.



Render showing the light attenuation of a Constant falloff light type with the Sphere option active.

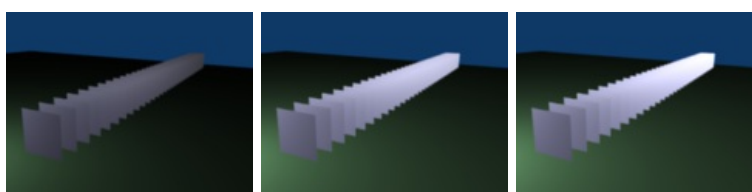


Render showing the light attenuation of a Constant falloff light type with the Sphere option deactivated.

Examples

Distance

In this example, the Lamp has been set pretty close to the group of planes. This causes the light to affect the front, middle and rear planes more dramatically. Looking at (*Various Distance settings*), you can see that as the Dist is increased, more and more objects are becoming progressively brighter.



Distance: **10.**

Distance: **100.**

Distance: **1000.**

Various Distance settings (shadows disabled).

The Distance parameter is controlling where the light is falling – at a linear rate by default – to half its original value from the light's

origin. As you increase or decrease this value, you are changing where this half falloff occurs. You could think of Distance as the surface of a sphere and the surface is where the light's intensity has fallen to half its strength, in all directions. Note that the light's intensity continues to fall even after Distance. Distance just specifies the distance where half of the light's energy has weakened.

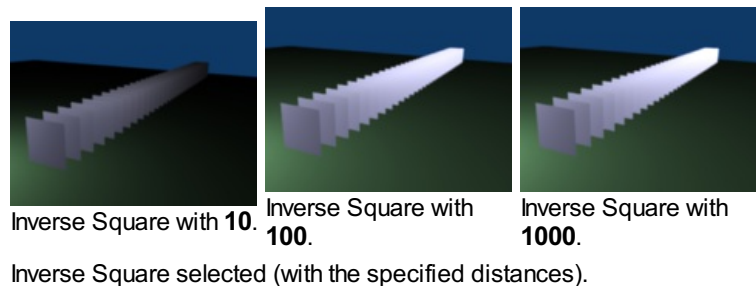
Notice in (*Distance: 1000*) that the farthest objects are very bright. This is because the falloff has been extended far into the distance which means the light is very strong when it hits the last few objects. It is not until **1000** units that the light's intensity has fallen to half of its original intensity.

Contrast this with (*Distance: 10*), where the falloff occurs so soon that the farther objects are barely lit. The light's intensity has fallen by a half by time it even reaches the tenth object.

You may be wondering, why the first few planes appear to be dimmer? This is because the surface angle between the light and the object's surface normal are getting close to oblique. That is the nature of a Lamp light object. By moving the light infinitely far away you would begin to approach the characteristics of the Sun lamp type.

Inverse Square

Inverse Square makes the light's intensity falloff with a non-linear rate, or specifically, quadratic rate. The characteristic feature of using Inverse Square is that the light's intensity begins to fall off very slowly but then starts falling off very rapidly. We can see this in the (*Inverse Square selected*) images.



With Inverse Square selected, the Distance field is specifying where the light begins to fall faster, roughly speaking, see the light attenuation [description](#) for more info.

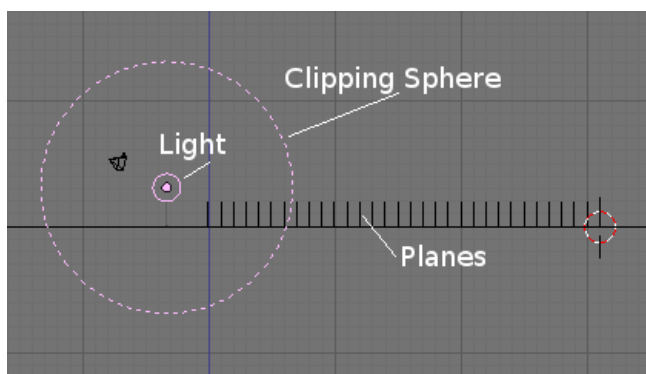
In (*Inverse Square with 10*), the light's intensity has fallen so quickly that the last few objects aren't even lit.

Both (*Inverse Square with 100*) and (*Inverse Square with 1000*) appear to be almost identical and that is because the Distance is set beyond the farthest object's distance which is at about **40 BU** out. Hence, all the objects get almost the full intensity of the light.

As above, the first few objects are dimmer than farther objects because they are very close to the light. Remember, the brightness of an object's surface is also based on the angle between the surface normal of an object and the ray of light coming from the lamp.

This means there are at least two things that are controlling the surface's brightness: intensity and the angle between the light source and the surface's normal.

Sphere

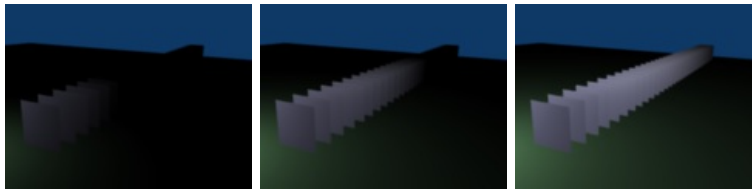


Clipping Sphere.

Sphere indicates that the light's intensity is null at the Distance distance and beyond, regardless of the chosen light's falloff. In (*Clipping Sphere*) you can see a side view example of the setup with Sphere enabled and a distance of **10**.

Any objects beyond the sphere receive no light from the lamp.

The Distance field is now specifying both where the light's rays become null, and the intensity's ratio falloff setting. Note that there is no abrupt transition at the sphere: the light attenuation is progressive (for more details, see the descriptions of the [Sphere options](#) and [light attenuations](#) above).



Sphere with **10**.

Sphere with **20**.

Sphere with **40**.

Sphere enabled with the specified distances, Inverse Linear light falloff.

In (*Sphere with 10*), the clipping sphere's radius is **10** units, which means the light's intensity is also being controlled by **10** units of distance. With a linear attenuation, the light's intensity has fallen very low even before it gets to the first object.

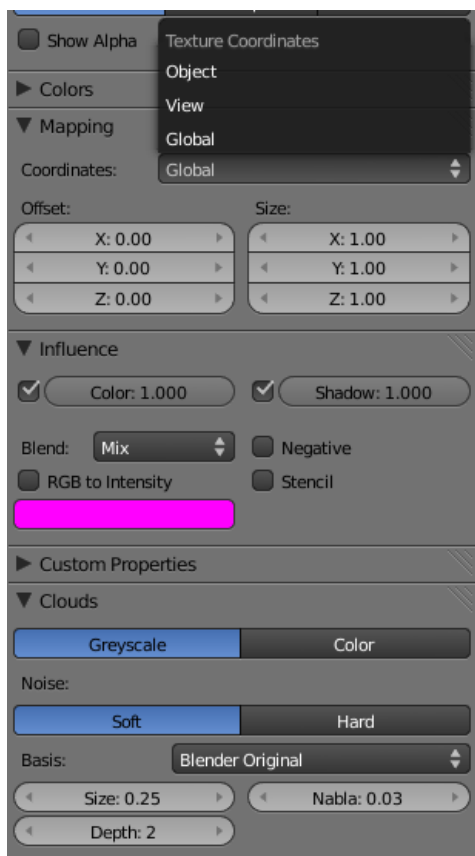
In (*Sphere with 20*), the clipping sphere's radius is now **20 BU** and some light is reaching the middle objects.

In (*Sphere with 40*), the clipping sphere's radius is now **40** units, which is beyond the last object. However, the light doesn't make it to the last few objects because the intensity has fallen to nearly **0**.

Hints

If a Lamp light is set to not cast shadows, it illuminates through walls and the like. If you want to achieve some nice effects like a fire, or a candle-lit room interior seen from outside a window, the Sphere option is a must. By carefully working on the Distance value you can make your warm firelight shed only within the room, while illuminating outside with a cool moonlight, the latter achieved with a Sun or Hemi light or both.

Lamps Textures



Lamp Texture panels

When a new lamp is added, it produces light in a uniform, flat color. While this might be sufficient in simple renderings, more sophisticated effects can be accomplished through the use of [textures](#). Subtle textures can add visual nuance to a lamp, while hard textures can be used to simulate more pronounced effects, such as a disco ball, dappled sunlight breaking through treetops, or even a projector. These textures are assigned to one of ten channels, and behave exactly like material textures, except that they affect a lamp's color and intensity, rather than a material's surface characteristics.

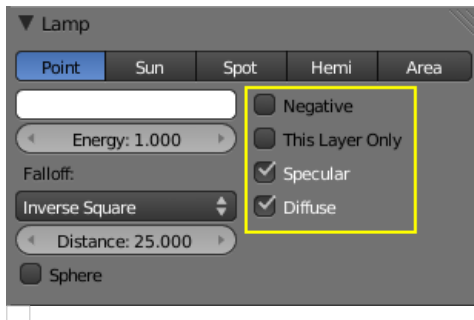
Options

The lamp textures settings are regrouped in two panels. Here we will only talk about the few things that differ from usual material textures, see the [Materials](#) and [Textures](#) chapters for details about the standard options.

The texture-specific and the Mapping panels remains the same. However, you'll note there are much less Mapping options – you can only choose between Global, View or another Object's texture coordinates (as a lamp has no texture coordinates by itself), and you can scale or offset the texture.

The Mapping panel is also a subset of its regular material's counterpart. You can only map a lamp texture to its regular, basic Color and/or to its Shadow color. As you can only affect colors, and a lamp has no texture coordinates on its own, the Diffuse, Specular, Shading, and Geometry options have disappeared.

What the Light Affects



Lamp panel with the light affecting options highlighted

Every lamp has a set of switches that control which objects receive its light, and how it interacts with materials.

Negative

The light produced by the lamp is **subtracted** from the one “available” on the surfaces it hits, which darkens these surfaces instead of brightening them.

This Layer Only

Causes the lamp to only light objects on the same layer.

Diffuse

Prevents the lamp from producing [diffuse light](#) (it doesn't really “light” things).

Specular

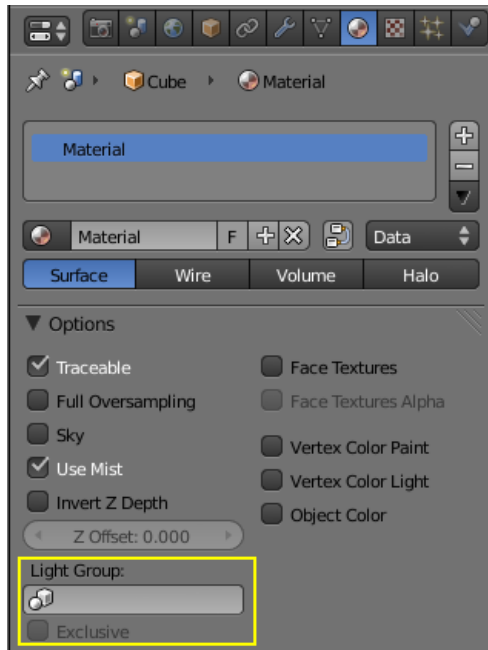
Prevents the lamp from producing [specular highlights](#).

Lamps Related Settings

Here are some options closely related to light sources, without being lamps settings.

Lighting Groups

Materials

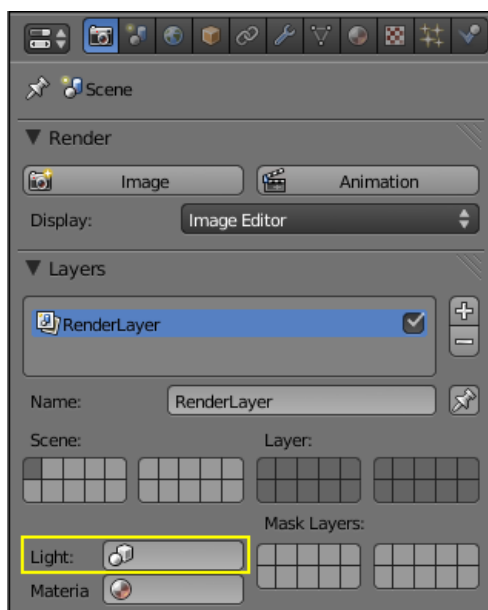


Light Group options for Materials

By default, materials are lit by all lamps in all visible layers, but a material (and thus all objects using that material) can be limited to a single group of lamps. This sort of control can be incredibly useful, especially in scenes with complex lighting setups. To enable this, navigate to the Material menu's Options panel and select a group of lamps in the Light Group field. Note that a [light group](#) must be created first.

If the Exclusive button is enabled, lights in the specified group will *only* affect objects with this material.

Scene



Light Group options for Render Layers

There's a similar control located in the Render menu's [Render Layers panel](#). If a light group name is selected in this Light field, the scene will be lit exclusively by lamps in the specified group.

See Also

- [Lamps Introduction](#)
- [Shadows](#)
- [Materials Introduction](#)

Shadows

Light wouldn't even exist without its counterpart: shadows. Shadows are a darkening of a portion of an object because light is being partially or totally blocked from illuminating the object. They add contrast and volume to a scene; there is nearly no places in the real world without shadows, so to get realistic renders, you will need them. Blender supports the following kind of shadows:

1. [Ray-traced lamp shadows](#)
2. [Buffered lamp shadows](#)
3. [Ambient occlusion](#)
4. [Indirect lighting](#)

Ambient occlusion really isn't a shadow based on light *per se*, but based on geometry. However, it does mimic an effect where light is prevented from fully and uniformly illuminating an object, so it is mentioned here. Also, it is important to mention ambient lighting, since increasing Ambient decreases the effect of a shadow.

You can use a combination of ray-traced and buffer shadows to achieve different results. Even within ray-traced shadows, different lamps cast different patterns and intensities of shadow. Depending on how you arrange your lamps, one lamp may wipe out or override the shadow cast by another lamp.

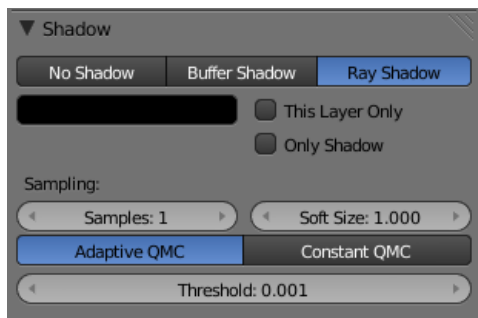
Shadows is one of those trifectas in Blender, where multiple things have to be set up in different areas to get results:

1. The lamp has to cast shadows (ability and direction).
2. Opaque object has to block light on its way (position and layer).
3. Another object's material has to receive shadows (Shadow and Receive Transparent enabled).
4. The render engine has to calculate shadows (Shadow for buffered shadows, Shadow and Ray for ray-traced shadows).

For example, the simple Lamp, Area, and Sun light has the ability to cast ray shadows, but not buffer shadows. The Spot light can cast both, whereas the Hemi light does not cast any. If a Sun lamp is pointing sideways, it will not cast a shadow from a sphere above a plane onto the plane, since the light is not traveling that way. All lamps able to cast shadows share some common options, described [here](#).

Just to give you more shadow options (and further confuse the issue), lamps and materials can be set to respectively **only** cast and receive shadows, and not light the diffuse/specular aspects of the object. Also, render layers can turn on/off the shadow pass, and their output may or may not contain shadow information...

Lamps: Ray-traced Shadows



Ray Shadow enabled for a lamp

Ray-traced shadows produce very precise shadows with very low memory use, but at the cost of processing time. This type of shadowing is available to all lamp types except Hemi.

As opposed to [buffered shadows](#), ray-traced shadows are obtained by casting rays from a regular light source, uniformly and in all directions. The ray-tracer then records which pixel of the final image is hit by a ray light, and which is not. Those that are not are obviously obscured by a shadow.

Each light casts rays in a different way. For example, a Spot light casts rays uniformly in all directions within a cone. The Sun light casts rays from an infinitely distant point, with all rays parallel to the direction of the Sun light.

For each additional light added to the scene, with ray-tracing enabled, the rendering time increases. Ray-traced shadows require more computation than buffered shadows but produce sharp shadow borders with very little memory resource usage.

To enable ray-traced shadows, three actions are required:

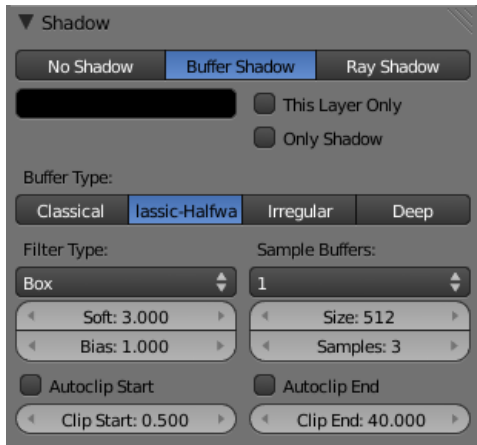
- Enable Shadows globally in the Render menu's Shading panel.
- Enable Ray tracing globally from the same panel.
- Enable ray-traced shadows for the light using the Ray Shadow button in the Light menu's Shadow panel. This panel varies depending on the type of light.

- All lamps able to cast ray-traced shadows share some common options, described in [Ray-traced Properties](#).

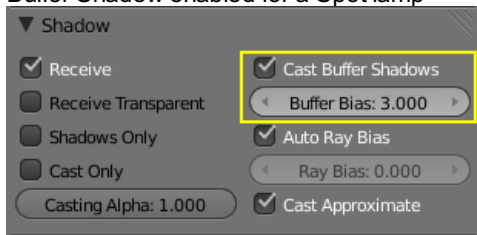
Ray-traced shadows can be cast by the following types of lamp:

- [Point lamp](#)
- [Spot lamp](#)
- [Area lamp](#)
- [Sun lamp](#)

Lamps: Buffered Shadows



Buffer Shadow enabled for a Spot lamp



Cast Buffer Shadows enabled for a material

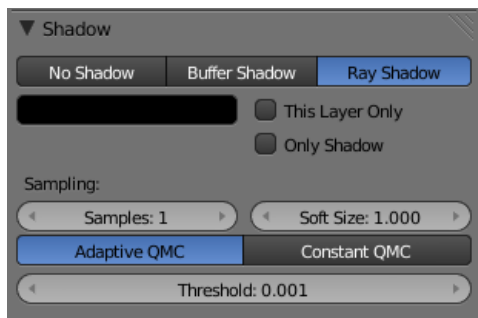
Buffered shadows provides fast rendered shadows at the expense of precision and/or quality. Buffered shadows also require more memory resources as compared to raytracing. Using buffered shadows depends on your requirements. If you are rendering animations or can't wait hours to render a complex scene with soft shadows, buffer shadows are a good choice.

For a scanline renderer – and Blender's built-in engine *is*, among other things, a scanline renderer –, shadows can be computed using a *shadowbuffer*. This implies that an "image", as seen from the spot lamp's point of view is "rendered" and that the distance – in the image – for each point from the spot light is saved. Any point in the "rendered" image that is farther away than any of those points in the spot light's image is then considered to be in shadow. The shadow buffer stores this image data.

To enable buffered shadows two actions are required:

- Enable shadows globally from the Scene menu's Gather panel by selecting Approximate.
- Enable shadows for the light using the Buffer Shadow button in the Lamp menu's Shadow panel.
- Make sure the Cast Buffer Shadows options is enabled in each Material's Shadow panel.
- The [Spot lamp](#) is the only lamp able to cast buffered shadows.

Common Shadowing Lamps Options



Common shadowing options for lamps

All lamps able to cast shadows ([Lamp](#), [Spot](#), [Area](#) and [Sun](#)) share some options, described below:

This Layer Only

When this option is enabled, only the objects on the same layer as the light source will cast shadows.

Only Shadow

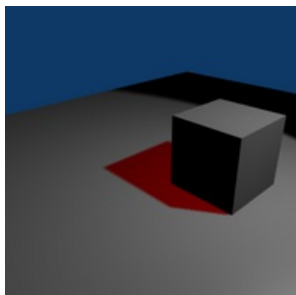
The light source will not illuminate an object but will generate the shadows that would normally appear.

This feature is often used to control how and where shadows fall by having a light which illuminates but has no shadow, combined with a second light which doesn't illuminate but has Only Shadow enabled, allowing the user to control shadow placement by moving the "Shadow Only" light around.

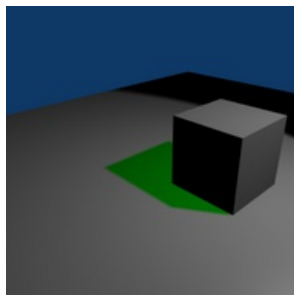
Shadow color

This color picker control allows you to choose the color of your cast shadows (black by default).

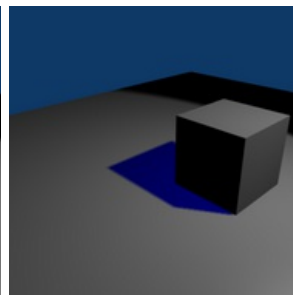
The images below were all rendered with a white light and the shadow color was selected independently.



Red colored shadow example



Green colored shadow example



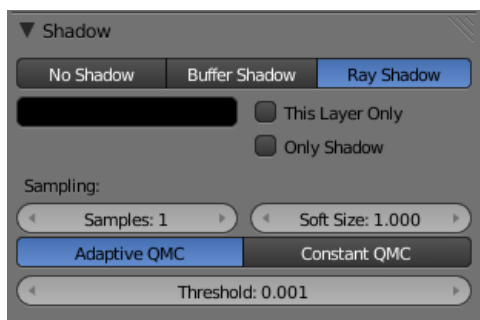
Blue colored shadow example

Although you can select a pure white color for a shadow color, it appears to make a shadow disappear.

See Also

- [Shadows](#)
- [Common Raytraced Options](#)
- [Lamp Light Raytraced Shadows](#)
- [Spot Light Raytraced Shadows](#)
- [Area Light Raytraced Shadows](#)
- [Sun Light Raytraced Shadows](#)
- [Spot Light Buffered Shadows](#)

Lamps Raytraced Shadows



Ray shadowing options for lamps

Most lamp types ([Lamp](#), [Spot](#) and [Sun](#)) share the same options for the raytraced shadows generation, which are described below. Note that the [Area](#) lamp, even though using most of these options, have some specificities described in its [own raytraced shadows page](#).

Ray Shadow

The Ray Shadow button enables the light source to generate raytraced shadows.

When the Ray Shadow button is selected, another set of options is made available, those options being:

Shadow sample generator type

Method for generating shadow samples: Adaptive QMC is fastest, Constant QMC is less noisy but slower.

This allows you to choose which algorithm is to be used to generate the samples that will serve to compute the raytraced shadows (for now, mainly two variants of Quasi-Monte Carlo, see [below](#)):

Constant QMC

The Constant QMC method is used to calculate shadow values in a very uniform, evenly distributed way. This method results in very good calculation of shadow value but it is not as fast as using the Adaptive QMC method, however Constant QMC is more accurate.

Adaptive QMC

The Adaptive QMC method is used to calculate shadow values in a slightly less uniform and distributed way. This method results in good calculation of shadow value but not as good as Constant QMC. The advantage of using Adaptive QMC is that it is in general much quicker while being not much worse than Constant QMC in terms of overall results.

Samples

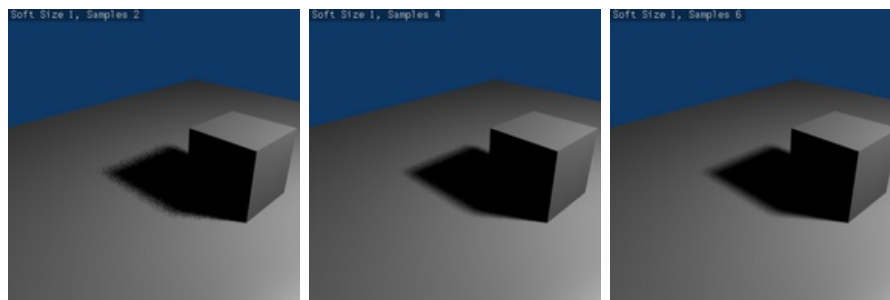
Amount of samples taken extra (samples x samples).

This slider sets the maximum number of samples that both Constant QMC and Adaptive QMC will use to do their shadow calculations. The maximum value is **16** – the real number of samples being actually the square of it, so setting a sample value of **3** really means $3^2 = 9$ samples will be taken.

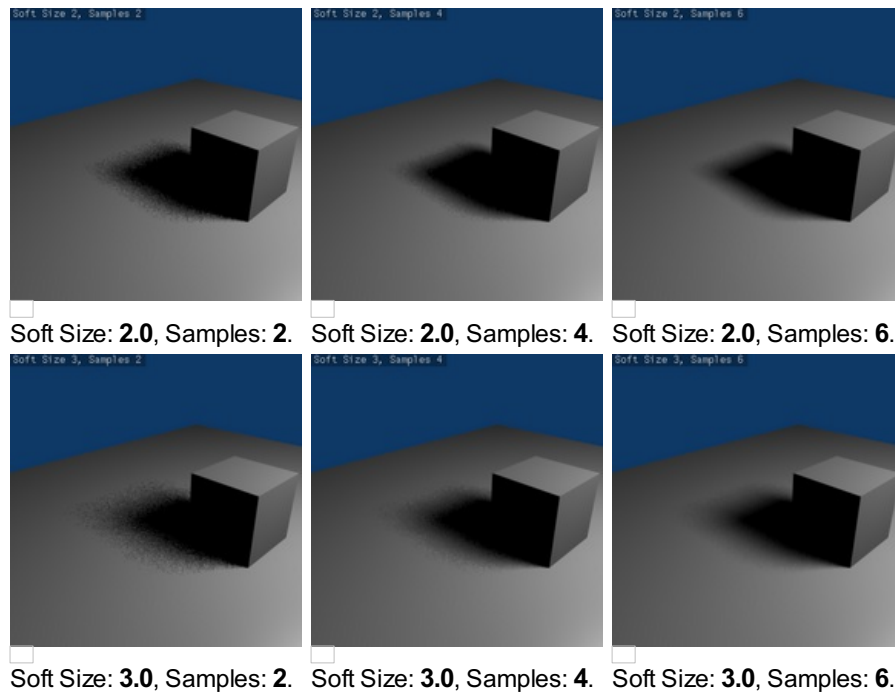
Soft Size

Light size for ray shadow sampling. This slider determines the size of the fuzzy/diffuse/penumbra area around the edge of a shadow. Soft Size only determines the width of the soft shadow size, not how graded and smooth the shadow is. If you want a wide shadow which is also soft and finely graded, you must also set the number of samples in the Samples field higher than **1**, otherwise this field has no visible effect and the shadows generated will not have a soft edge. The maximum value for Soft Size is **100.0**.

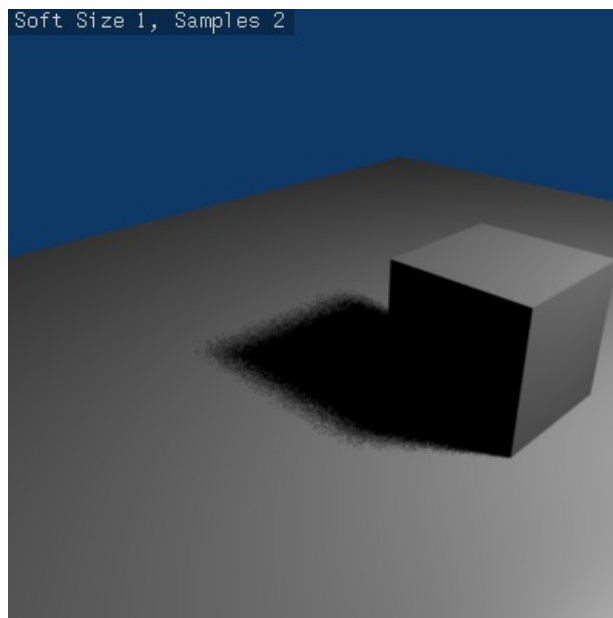
Below is a table of renders with different Soft Size and Samples settings showing the effect of various values on the softness of shadow edges:



Soft Size: **1.0**, Samples: **2**. Soft Size: **1.0**, Samples: **4**. Soft Size: **1.0**, Samples: **6**.



Below is an animated version of the above table of images showing the effects:



You may need to click on the image to see the animation.

Threshold

Threshold for Adaptive Sampling. This field is used with the Adaptive QMC shadow calculation method. The value is used to determine if Adaptive QMC shadow sample calculation can be skipped based on a threshold of how shadowed an area is already. The maximum Threshold value is **1.0**.

What is Quasi-Monte Carlo?

The Monte Carlo method is a method of taking a series of samples/readings of values (any kind of values, such as light values, color values, reflective states) in or around an area at random, so as to determine the correct actions to take in certain calculations which usually require multiple sample values to determine overall accuracy, of those calculations. The Monte Carlo methods tries to be as random as possible, this can often cause areas that are being sampled to have large irregular gaps in them (places that are not sampled/read), this in turn can cause problems for certain calculations (such as shadow calculation).

The solution to this was the Quasi-Monte Carlo method.

The Quasi-Monte Carlo method is also random, but tries to make sure that the samples/readings it takes are also better distributed (leaving less irregular gaps in its sample areas) and more evenly spread across an area. This has the advantage of sometimes leading to more accurate calculations based on samples/reading.

Volumetric Lighting

According to Wikipedia, [volumetric lighting](#)

« is a technique used in 3D computer graphics to add lighting effects to a rendered scene. It allows the viewer to see beams of light shining through the environment; seeing sunbeams streaming through an open window is an example of volumetric lighting, also known as God rays. The term seems to have been introduced from cinematography and is now widely applied to 3D modeling and rendering especially in the field of 3D gaming.

In volumetric lighting, the light cone emitted by a light source is modeled as a transparent object and considered as a container of a "volume": as a result, light has the capability to give the effect of passing through an actual three dimensional medium (such as fog, dust, smoke, or steam) that is inside its volume, just like in the real world. »

A classic example is the search light with a visible halo/shaft of light being emitted from it as the search light sweeps around.

By default Blender does not model this aspect of light. For example when Blender lights something with a Spot light, you see the objects and area on the floor lit but not the shaft/halo of light coming from the spotlight as it progresses to its target and would get scattered on the way.

The halo/shaft of light is caused in the real world by light being scattered by particles in the air, some of which get diverted into your eye and that you perceive as a halo/shaft of light. The scattering of light from a source can be simulated in Blender using various options, but by default is not activated.

The only lamp able to create volumetric effects is the [Spot lamp](#) (even though you might consider some of the ["Sky & Atmosphere" effects](#) of the Sun lamp as volumetric as well).

Example

[Blend file of spotlight animation.](#)

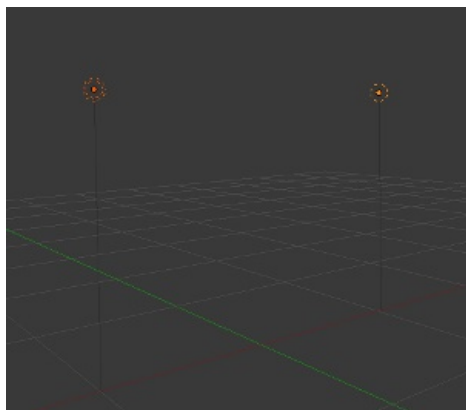
See also

- [Mist](#)
- [Smoke](#)
- [Volumetric Materials](#)

Lamps

Blender comes equipped with five different lamp types, each with its own unique strengths and limitations. Here are the available lamps:

- [Point](#) is an omni-directional point light source, similar to a light bulb.
- [Spot](#) is a directional point light source, similar to... a spot.
- [Area](#) is a source simulating area producing light, as windows, neons, TV screens.
- [Hemi](#) simulates a very wide and far away light source, like the sky.
- [Sun](#) simulates a very far away and punctual light source, like the sun.



Visual height and shadow markers of two points lamps. Ray Shadow is enabled on the left lamp.

You can add new lamps to a scene using the Add menu in the top header, or with ( ShiftA » Add » Lamp).

Once added, a lamp's position is indicated in the 3D View by a solid dot in a circle, but most types also feature dashed wire-frames that help describe their orientation and properties. While each type is represented differently, there are some visual indicators common to all of them:

Shadows

If shadows are enabled, an additional dashed circle is drawn around the solid circle. This makes it easier to quickly determine if a lamp has shadows enabled.

Vertical Height Marker

This is a dim grey line, which helps locate the lamp's position relative to the global X-Y plane.

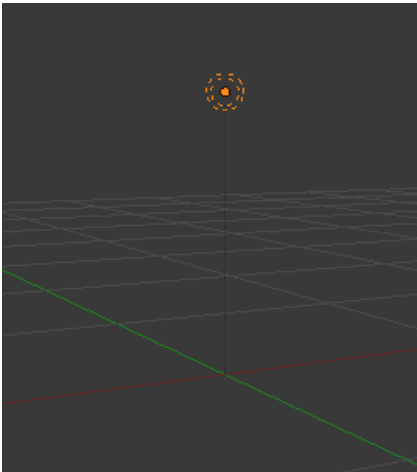
Page status ([reviewing guidelines](#))

Proposed split

Text like 2.4

Proposed fixes: none

Point Lights



Point lamp

The Point lamp is an omni-directional point of light, that is, a point radiating the same amount of light in all directions. It's visualized by a plain, circled dot. Being a point light source, the direction of the light hitting an object's surface is determined by the line joining the lamp and the point on the surface of the object itself.

Light intensity/energy decays based on (among other variables) distance from the Point lamp to the object. In other words, surfaces that are further away are rendered darker.

Lamp Options

Common options

Distance, Energy and Color

These settings are common to most types of lamps, and are described in [Light Properties](#).

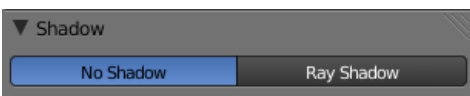
Negative, This Layer Only, Specular, and Diffuse

These settings control what the lamp affect, as described in [What Light Affects](#).

Falloff and Sphere

These settings control how the light of the Lamp decays with the distance. See [Light Attenuation](#) for details.

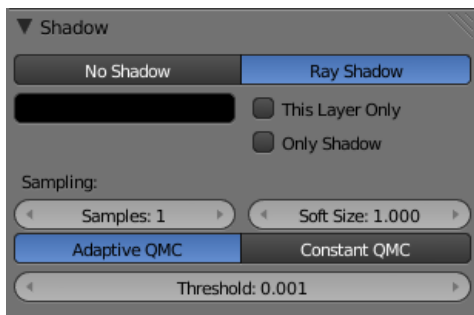
Shadow



Without ray shadows

When a Lamp light source is selected the Shadow panel has the following default layout:

Raytraced Shadows



Point lamp with ray shadows and Adaptive QMC sample generator enabled

The Point light source can only cast raytraced shadows. It shares with other lamp types common shadows options described in [Shadow Properties](#).

The raytraced shadows settings of this lamp are shared with other ones, and are described [Raytraced Properties](#).

moved to [Doc:2.5/Manual/Lighting/Lamps/Point](#)

Page status ([reviewing guidelines](#))

Proposed split

Text like 2.4

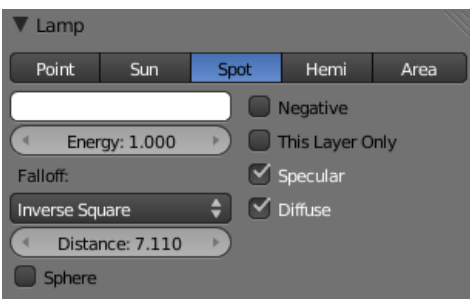
Proposed fixes: none

Spot Lamp

A Spot lamp emits a cone shaped beam of light from the tip of the cone, in a given direction.

The Spot light is the most complex of the light objects and indeed, for a long time, among the most used thanks to the fact that it was the only one able to cast shadows. Nowadays, with a ray tracer integrated into Blender's internal render engine, all lamps can cast shadows (except Hemi). Even so, Spot lamps' shadow buffers are much faster to render than raytraced shadows, especially when blurred/softened, and spot lamps also provide other functionality such as "volumetric" halos.

Lamp options



Common Lamp options of a Spot

Common options

Distance, Energy and Color

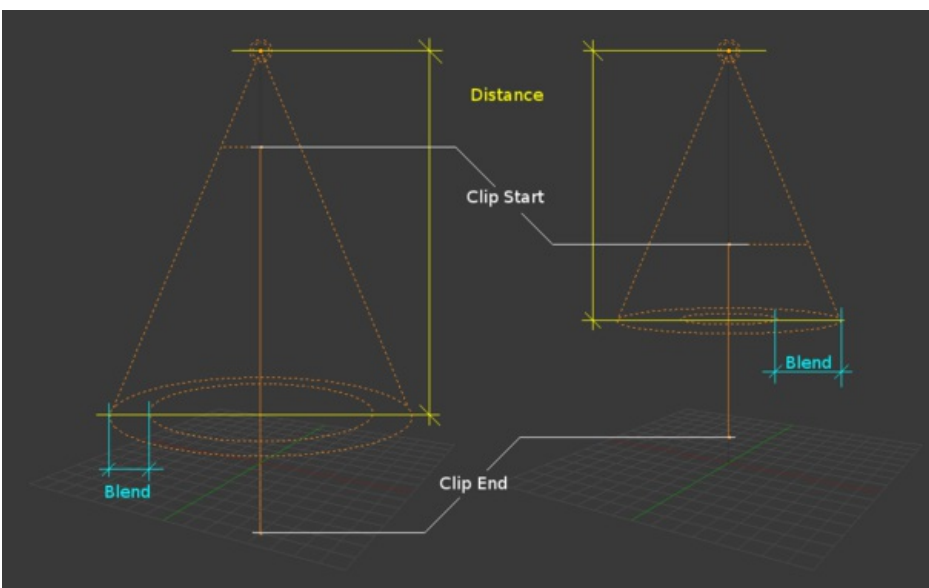
These settings are common to most types of lamps, and are described in [Light Properties](#).

The This Layer Only, Negative, Diffuse and Specular

These settings control what the lamp affect, as described in [What Light Affects](#).

Light Falloff and Sphere

These settings control how the light of the Spot decays with the distance. See [Light Attenuation](#) for details.



Changing the Spot options also changes the appearance of the spotlight as displayed in the 3D View

Shadow options

No Shadow

Choose this to turn shadows off for this spot lamp. This can be useful to add some discreet directed light to a scene.

Buffer Shadow

See [Buffered Spot Shadows](#)

Ray Shadow

See [Spot Raytraced Shadows](#)

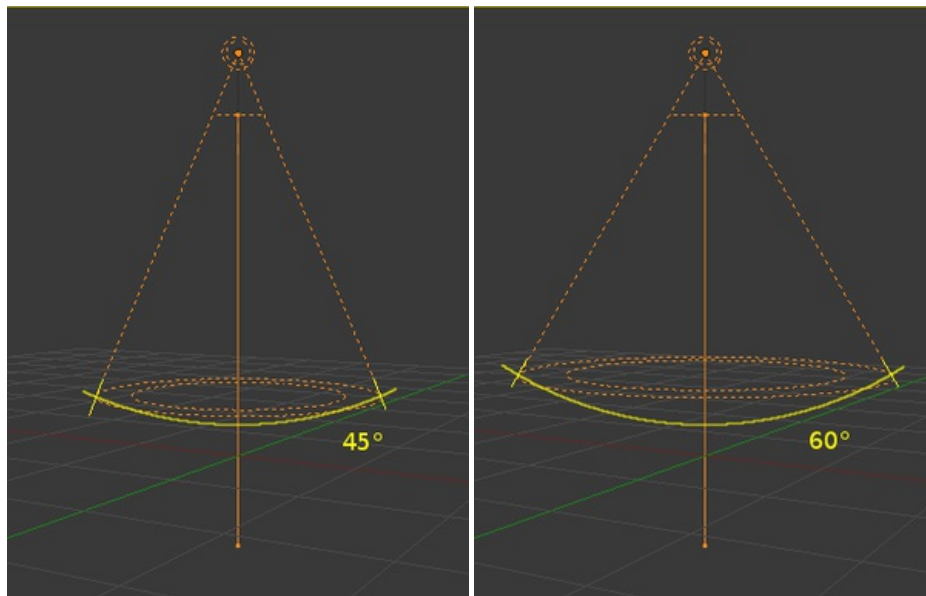
Spotlights can use either raytraced shadows or [buffered shadows](#). Either of the two can provide various extra options. Raytraced shadows are generally more accurate, with extra capabilities such as transparent shadows, although they are quite slower to render.

Buffered shadows are more complex to set up and involve more faking, but the speed of rendering is a definite advantage. Nevertheless, it shares with other lamp types common shadows options described in [Shadows Properties](#).

Spot Shape Options

Size

The size of the outer cone of a Spot, which largely controls the circular area a Spot light covers. This slider controls in fact the angle at the top of the lighting cone, and can be between **1.0°** and **180.0°**.



Changing the spot Size option

Blend

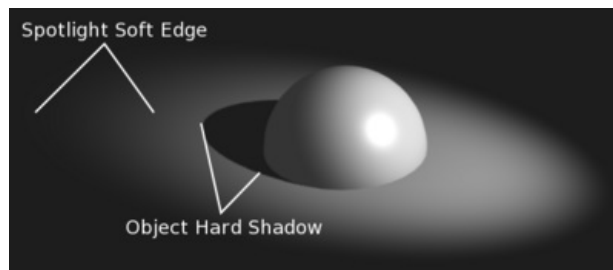
The Blend slider controls the inner cone of the Spot. The Blend value can be between **0.0** and **1.0**. The value is proportional and represents that amount of space that the inner cone should occupy inside the outer cone (Size).

The inner cone boundary line indicates the point at which light from the Spot will start to blur/soften, before this point its light will mostly be full strength. The larger the value of the Blend the more blurred/soft the edges of the spotlight will be, and the smaller the inner cones circular area will be (as it starts to blur/soften earlier).

To make the Spot have a sharper falloff rate and therefore less blurred/soft edges, decrease the value of Blend. Setting Blend to **0.0** results in very sharp spotlight edges, without any transition between light and shadow.

The falloff rate of the Spot lamp light is a ratio between the Blend and Size values, the larger the circular gap between the two, the more gradual the light fades between Blend and Size.

Blend and Size only control the Spot light cone's aperture and softness ("radial" falloff), they do not control the shadow's softness as shown below.



Render showing the soft edge spotlighted area and the sharp/hard object shadow

Notice in the picture above that the object's shadow is sharp as a result of the raytracing, whereas the spotlight edges are soft. If you want other items to cast soft shadows within the Spot area, you will need to alter other shadow settings.

Square

The Square button makes a Spot light cast a square light area, rather than the default circular one.

Show Cone

Draw a transparent cone in 3D view to visualize which objects are contained in it.

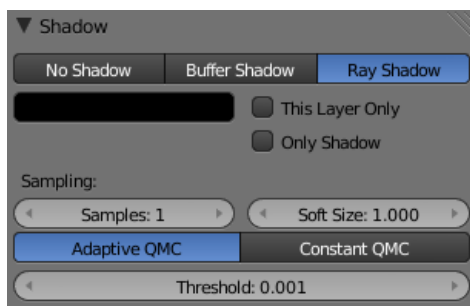
Halo

Adds a volumetric effects to the spot lamp. See [Spot Halos](#).

Buffer Shadow

Buffered Shadows are also known as depth map shadows. Shadows are created by calculating differences in the distance from the light to scene objects. See [Buffered Shadows](#) for full details on using this feature.

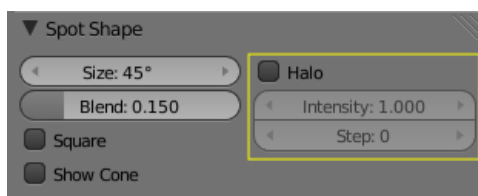
Spot Raytraced Shadows



Shadow panel set to Ray Shadow

The raytraced shadows settings of this lamp are shared with other ones, and are described in [Raytraced Properties](#).

Spot Volumetric Effects



Spot lamps's Halo options

Spot lights also can produce "volumetric" effects. See [Volumetric Light](#) for more information about what it means.

Halo

The Halo button allows a Spot lamp to have a volumetric effect applied to it. This button must be active if the volumetric effect is to be visible. Note that if you are using buffered shadows, you have extra options described in the [Spot Buffered Shadows](#) page.

Intensity

The Intensity slider controls how intense/dense the volumetric effect is, that is generated from the light source. The lower the value of the Intensity slider the less visible the volumetric effect is, while higher Intensity values give a much more noticeable and dense volumetric effect.

Step

This field can have a value between **0** and **12**. It is used to determine whether this Spot will cast volumetric shadows, and what quality those volumetric shadows will be.

If Step is set to a value of **0**, then no volumetric shadow will be generated.

Unlike most other controls, as the Step value increases, the quality of volumetric shadows decreases (but takes less time to render), and *vice-versa*.



Step values

A value of **8** for Halo Step is usually a good compromise between speed and accuracy.

Blender only simulates volumetric lighting in Spot lamps when using its internal renderer. This can lead to some strange results for certain combinations of settings for light's Energy and halo's Intensity.

For example having a Spot light with null or very low light Energy settings but a very high halo Intensity setting can result in a dark/black halo, which would not happen in the real world. Just be aware of this possibility when using halos with the internal renderer.

Note

The halo effect can be greatly enhanced when using buffered shadows: when the halo's Step is not null, they can create “volumetric shadows”. See the page about Spot [Buffered Shadows](#) for more information.

moved to [Doc:2.5/Manual/Lighting/Lamps/Spot](#)

Spot Buffered Shadows



Buffer Shadow enabled for a Spot lamp

Spotlights can use either [Raytraced Shadows](#) or buffered shadows. Either of the two can provide various extra options.

Raytraced shadows are generally more accurate, with extra capabilities such as transparent shadows, although they are quite slower to render.

Buffered shadows are more complex to set up and involve more faking, but the speed of rendering is a definite advantage. Nevertheless, it shares with other lamp types common shadows options described in [Shadows Properties](#).

Shadow Buffer Types

When the Buffer Shadow button is activated, the currently selected Spot light generates shadows, using a “shadow buffer” rather than using raytracing, and various extra options and buttons appear in the Shadow panel.

Buffer Type

There more than one way to generate buffered shadows. The shadow buffer generation type controls which generator to use.

There are four shadow generation types, those being:

- Classical
- Classic-Halfway
- Irregular
- Deep

For more information on the different shadow generation methods see these links:

- [Development Release Logs 2.43: Irregular Shadow Buffer](#)
- [Blender Nation: Blender Gets Irregular Shadow Buffers](#)
- [Development Release Logs 2.43: Shadow Buffer Halfway Average](#)

“Classical” and “Classic-Halfway” generation methods



Buffer Shadowset to Classic-Halfway

Classical

A shadow generation which used to be the Blender default and unique method for generation of buffered shadows. It used an older way of generating buffered shadows, but it could have some problems with accuracy of the generated shadows and can be very sensitive to the resolution of the shadow buffer (Shadow Buffer→Size), different Bias values, and all the self-shadowing issues that brings up.

The Classical method of generating shadows is obsolete and is really only still present to allow for backward compatibility with older versions of Blender. In most other cases you will want to use Classic-Halfway instead.

Classic-Halfway

This shadow buffer type is an improved shadow buffering method and is the default option selected in Blender. It works by taking an averaged reading of the first and second nearest Z depth values allowing the Bias value to be lowered and yet not suffer as much from self-shadowing issues.

Not having to increase Bias values helps with shadow accuracy, because large Bias values can mean small faces can lose their shadows, as well as preventing shadows being overly offset from the larger Bias value.

Classic-Halfway doesn't work very well when faces overlap, and biasing problems can happen.

Here are now the options specific to these generation methods:

Size

The Size numeric field can have a value from **512** to **10240**. Size represents the resolution used to create a shadow map. This shadow map is then used to determine where shadows lay within a scene.

As an example, if you have a Size with a value of **1024**, you are indicating that the shadow data will be written to a buffer which will have a square resolution of **1024×1024** pixels/samples from the selected spotlight.

The higher the value of Size, the higher resolution and accuracy of the resultant shadows, assuming all other properties of the light and scene are the same, although more memory and processing time would be used. The reverse is also true – if the Size value is lowered, the resultant shadows can be of lower quality, but would use less memory and take less processing time to calculate.

As well as the Size value affecting the quality of generated shadows, another property of Spot lamps that affects the quality of their buffered shadows is the angle of the spotlights lighted area (given in the Spot Shape panel's Size field).

As the spot shape Size value is increased, the quality of the cast shadows degrades. This happens because when the Spot lighted area is made larger (by increasing spot shape Size), the shadow buffer area has to be stretched and scaled to fit the size of the new lighted area.

The Size resolution is not altered to compensate for the change in size of the spotlight, so the quality of the shadows degrades. If you want to keep the generated shadows the same quality, as you increase the spot shape Size value, you also need to increase the buffer Size value.

The above basically boils down to

If you have a spotlight that is large you will need to have a larger buffer Size to keep the shadows good quality. The reverse is true also – the quality of the generated shadows will usually improve (up to a point) as the Spot lamp covers a smaller area.

Filter Type

The Box, Tent, and Gauss filter types control what filtering algorithm to use to anti-alias the buffered shadows.

They are closely related to the Samples numeric field, as when this setting is set to **1**, shadow filtering is disabled, so none of these buttons will have any effect whatsoever.

Box

The buffered shadows will be anti-aliased using the “box” filtering method.

This is the original filter used in Blender. It is relatively low quality and is used for low resolution renders, as it produces very sharp anti-aliasing. When this filter is used, it only takes into account oversampling data which falls within a single pixel, and doesn't take into account surrounding pixel samples. It is often useful for images which have sharply angled elements and horizontal/vertical lines.

Tent

The buffered shadows will be anti-aliased using the “tent” filtering method.

It is a simple filter that gives sharp results, an excellent general purpose filtering method. This filter also takes into account the sample values of neighboring pixels when calculating its final filtering value.

Gauss

The buffered shadows will be anti-aliased using the “Gaussian” filtering method.

It produces a very soft/blurry anti-aliasing. As result, this filter is excellent with high resolution renders.

The [Anti-Aliasing page](#) in the Render chapter will give more information on the various filtering/distribution methods and their uses.

Samples

The Samples numeric field can have a value between **1** and **16**. It controls the number of samples taken per pixel when calculating shadow maps.

The higher this value, the more filtered, smoothed and anti-aliased the shadows cast by the current lamp will be, but the longer they will take to calculate and the more memory they will use. The anti-aliasing method used is determined by having one of the Box, Tent or Gauss buttons activated (see above).

Having a Samples value of **1** is similar to turning off anti-aliasing for buffered shadows.

Soft

The Soft numeric field can have a value between **1.0** and **100.0**. It indicates how wide an area is sampled when doing anti-aliasing on buffered shadows. The larger the Soft value, the more graduated/soft the area that is anti-aliased/softened on the edge of generated shadows.

Sample Buffers

The Sample Buffers setting can be set to values **1**, **4** or **9**, and represents the number of shadow buffers that will be used when doing anti-aliasing on buffered shadows.

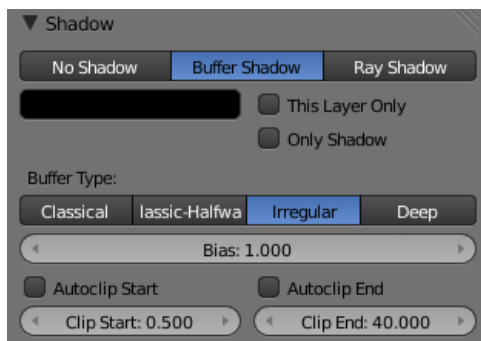
This option is used in special cases, like very small objects which move and need to generate really small shadows (such as strands). It appears that normally, pixel width shadows don't anti-alias properly, and that increasing Buffer Size doesn't help much.

So this option allows you to have a sort of extra sample pass, done above the regular one (the one controlled by the Box/Tent/Gauss, Samples and Soft settings).

The default **1** value will disable this option.

Higher values will produce a smoother anti-aliasing – but be careful: using a Sample Buffers of **4** will require four times as much memory and process time, and so on, as Blender will have to compute that number of sample buffers.

“Irregular” generation method



Buffer Shadow set to Irregular

Irregular shadow method is used to generate sharp/hard shadows that are placed as accurately as raytraced shadows. This method offers very good performance because it can be done as a multi-threaded process.

This method supports transparent shadows. To do so, you will first need to setup the shadow setting for the object which will receive the transparent shadow. (Material → Shadow → Cat Buffer Shadows and Buffer Bias)

Deep generation method



Buffer Shadow set to Deep

Deep Shadow buffer supports transparency and better filtering , at the cost of more memory usage and processing time

Compress: Deep shadow map compression treshold

Common options

The following settings are common to all buffered shadow generation method.

Bias

The Bias numeric field can have a value between **0.001** and **5.0**. Bias is used to add a slight offset distance between an object and the shadows cast by it. This is sometimes required because of inaccuracies in the calculation which determines whether an area of an object is in shadow or not.

Making the Bias value smaller results in the distance between the object and its shadow being smaller. If the Bias value is too small, an object can get artifacts, which can appear as lines and interference patterns on objects. This problem is usually called “self shadowing”, and can usually be fixed by increasing the Bias value, which exists for that purpose!

Other methods for correcting self shadowing include increasing the size of the Shadow Buffer Size or using a different buffer shadow calculation method such as Classic-Halfway or Irregular.

Self shadowing interference tends to affect curved surfaces more than flat ones, meaning that if your scene has a lot of curved surfaces it may be necessary to increase the Bias value or Shadow Buffer Size value.

Having overly large Bias values not only places shadows further away from their casting objects, but can also cause objects that are very small to not cast any shadow at all. At that point altering Bias, Shadow Buffer Size or Spot Size values, among other things, may be required to fix the problem.

Finer Bias tuning

You can now refine the Bias value independently for each [Material](#), using the Bias slider (Material menu, Shadow panel). This value is a factor by which the Bias value of each Spot buffered shadows lamp is multiplied, each time its light hits an object using this material. The **0.0** and **1.0** values are equivalent – they do not alter the lamp’s Bias original value.

Clip Start & Clip End

When a Spot light with buffered shadows is added to a scene, an extra line appears on the Spot 3D view representation.

The start point of the line represents Clip Start’s value and the end of the line represents Clip End’s value. Clip Start can have a value between **0.1** and **1000.0**, and Clip End, between **1.0** and **5000.0**. Both values are represented in Blender Units.

Clip Start indicates the point after which buffered shadows can be present within the Spot light area. Any shadow which could be present before this point is ignored and no shadow will be generated.

Clip End indicates the point after which buffered shadows will not be generated within the Spot light area. Any shadow which could be present after this point is ignored and no shadow will be generated.

The area between Clip Start and Clip End will be capable of having buffered shadows generated.

Altering the Clip Start and Clip End values helps in controlling where shadows can be generated. Altering the range between Clip Start and Clip End can help speed up rendering, save memory and make the resultant shadows more accurate.

When using a Spot lamp with buffered shadows, to maintain or increase quality of generated shadows, it is helpful to adjust the

Clip Start and Clip End such that their values closely bound around the areas which they want to have shadows generated at. Minimizing the range between Clip Start and Clip End, minimizes the area shadows are computed in and therefore helps increase shadow quality in the more restricted area.

Autoclip Start & Autoclip End

As well as manually setting Clip Start and Clip End fields to control when buffered shadows start and end, it is also possible to have Blender pick the best value independently for each Clip Start and Clip End field.

Blender does this by looking at where the visible vertices are when viewed from the Spot lamp position.

Hints

Any object in Blender can act as a camera in the 3D view. Hence you can select the Spot light and switch to a view from its perspective by pressing Ctrl0 NumPad.

moved to [Doc:2.5/Manual/Lighting/Lamps/Spot](#)

Page status ([reviewing guidelines](#))

Proposed split

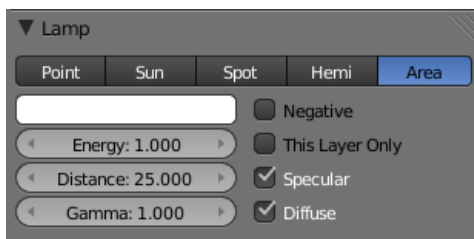
Text like 2.4

Proposed fixes: none

Area Lamp

The Area lamp simulates light originating from a surface (or surface-like) emitter, for example, a TV screen, your supermarket's neons, a window or a cloudy sky are just a few types. The area lamp produces shadows with soft borders by sampling a lamp along a grid the size of which is defined by the user. This is in direct contrast to point-like artificial lights which produce sharp borders.

Options



Commons Options

Common options

Distance, Energy and Color

These settings are common to most types of lamps, and are described in [Light Properties](#).

Note that the Distance setting is much more sensitive and important for Area lamps than for others, usually any objects within the range of Distance will be blown out and overexposed. For best results, set the Distance to just below the distance to the object that you want to illuminate.

Gamma

Amount to gamma correct the brightness of illumination. Higher values give more contrast and shorter falloff.

The Area lamp doesn't have light falloff settings. It uses an "inverse quadratic" attenuation law. The only way to control its falloff is to use the Distance and/or Gamma settings.

This Layer Only, Negative, Specular and Diffuse

These settings control what the lamp affect, as described in [What Light Affects](#).

Shadows

When an Area light source is selected, the Shadow panel has the following default layout:



Adaptive QMC settings

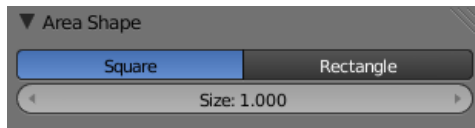
Constant Jittered settings

The Shadow panel when Area light source is selected

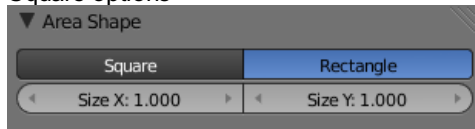
As its only purpose for this lamp is about raytraced shadows, it is described below: [Raytraced Shadows](#).

Area Shape

The shape of the area light can be set to Square or a Rectangle.



Square options



Rectangle options

Square/Rectangular

Emit light from either a square or a rectangular area

Size/Size X/Size Y

Dimensions for the Square or Rectangle

Shape Tips

Choosing the appropriate shape for your Area light will enhance the believability of your scene. For example, you may have an indoor scene and would like to simulate light entering through a window. You could place a Rectangular area lamp in a window (vertical) or from neons (horizontal) with proper ratios for Size X and Size Y. For the simulation of the light emitted by a TV-screen a vertical Square area lamp would be better in most cases.

Area Raytraced Shadows



Adaptive QMC settings

The Area light source can only cast raytraced shadows. The raytraced shadows settings of this lamp are mostly shared with other ones, as described in [Raytraced Properties](#). However, there are some specificities with this lamp, which are detailed below:

Shadow Samples

Samples

This have the same role as with other lamps, but when using a Rectangle Area lamp, you have two samples settings: Samples X and Samples Y, for the two axes of the area plane.

Note also that when using Constant Jittered sample generator method, this is more or less equivalent to the number of virtual lamps in the area. With QMC sample generator methods, it behave similarly as with Lamp or Spot lamps.

Sample Generator Types

Adaptive QMC;Constant QMC

These common setting are described in [Shadow Properties](#).



Constant Jittered settings

Constant Jittered

The Area lamp has a third sample generator method, Constant Jittered, which is more like simulating an array of lights. It has the same options as the old one: Umbra, Dither and Jitter.

The following three parameters are only available when using Constant Jittered sample generator method, and are intended to artificially boost the "soft" shadow effect, with possible loss in quality:

Umbra

Emphasizes the intensity of shadows in the area fully within the shadow rays. The light transition between fully shadowed areas and fully lit areas changes more quickly (i.e. a sharp shadow gradient). You need Samples values equal to or greater than **2** to see any influence of this button.

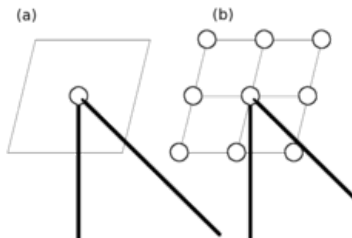
Dither

Applies a sampling over the borders of the shadows, in a similar same way anti-aliasing is applied by the OSA button on the borders of an object. It artificially softens the borders of shadows; when Samples is set very low, you can expect poor results, so Dither is better used with medium Samples values. It is not useful at all with high Samples values, as the borders will appear already soft.

Jitter

Adds noise to break up the edges of solid shadow samples, offsetting them from each other in a pseudo-random way. Once again, this option is not very useful when you use high Samples values where the drawback is that noise generates quite visible graininess.

Technical Details



Principles behind the Area light

The *(Principles behind the Area light)* picture helps to understand how the soft shadows are simulated.

(a) is the Area light as defined in Blender. If its shape is Square, then the softness of the shadow is defined by the number of light Samples in each direction of the shape. For example, (b) illustrates the equivalent case of an Area light (Square shape), with Samples set at **3** on the Shadow and Spot panel.

The Area lamp is then considered as a grid with a resolution of three in each direction, and with a light "dupliverbed" at each node for a total of nine lights.

In case (a), the energy (E) is $E/1$, and in case (b), the energy of each individual pseudo-light is equal to $E/(\text{Nbr of lights})$. Each pseudo-light produces a faint shadow (proportional to its energy), and the overlay of the shadows produces the soft shadow (it is darker where the individual shadows overlap, and lighter everywhere else).

Hints

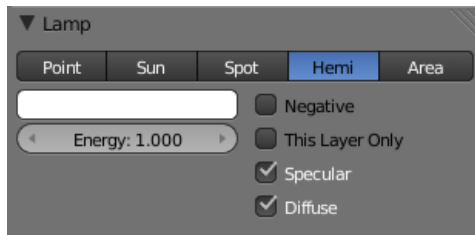
You will note that changing the Size parameter of your area lamp doesn't affect the lighting intensity of your scene. On the other hand, rescaling the lamp using the S in the 3D View could dramatically increase or decrease the lighting intensity of the scene. This behavior has been coded this way so that you can fine tune all your light settings and then decide to scale up (or down) the whole scene without suffering from a drastic change in the lighting intensity. If you only want to change the dimensions of your Area lamp,

without messing with its lighting intensity, you are strongly encouraged to use the Size button(s) instead.

If your computer isn't very fast, when using the Constant Jittered sample generator method, you could find it useful to set a low Samples value (like **2**) and activate Umbra, Dither, and/or Jitter in order to simulate slightly softer shadows. However, these results will never be better than the same lighting with high Samples values.

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Hemi Lamps



Hemi lamp's panel

The Hemi lamp provides light from the direction of a 180° hemisphere, designed to simulate the light coming from a heavily clouded or otherwise uniform sky. In other words, it is a light which is shed, uniformly, by a glowing dome surrounding the scene.

Similar to the Sun lamp, the Hemi's location is unimportant, while its orientation is key.

The Hemi lamp is represented with four arcs, visualizing the orientation of the hemispherical dome, and a dashed line representing the direction in which the maximum energy is radiated, the inside of the hemisphere.

Options

Energy and Color

These settings are common to most types of lamps, and are described in [Light Properties](#).

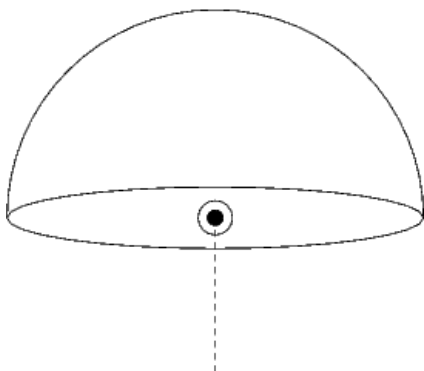
Layer, Negative, Specular, and Diffuse

These settings control what the lamp affect, as described in [What Light Affects](#).

The Hemi lamp has no light falloff settings: it always uses a constant attenuation (i.e. no attenuation).

Since this lamp is the only lamp which cannot cast any shadow, the Shadow panel is absent.

Technical Details



Hemi light conceptual scheme

Page status ([reviewing guidelines](#))

Proposed split

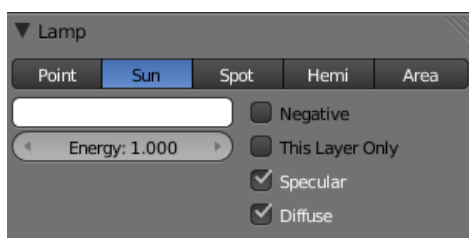
Text like 2.4

Proposed fixes: none

Sun Lamp

A Sun lamp provides light of constant intensity emitted in a single direction. In the 3D view, the Sun light is represented by an encircled black dot with rays emitting from it, plus a dashed line indicating the direction of the light. This direction can be changed by rotating the Sun lamp, as any other object, but because the light is emitted in a constant direction, the location of a Sun lamp does not affect the rendered result (unless you use the [“sky & atmosphere” option](#)). The Location of the sunlamp doesn't not affect anything.

Options



Sun lamp panel

Common options

Energy and Color

These settings are common to most types of lamps, and are described in [Light Properties](#).

Negative, This Layer Only, Specular, and Diffuse

These settings control what the lamp affect, as described in [What Light Affects](#).

The Sun lamp has no light falloff settings: it always uses a constant attenuation (i.e. no attenuation!).

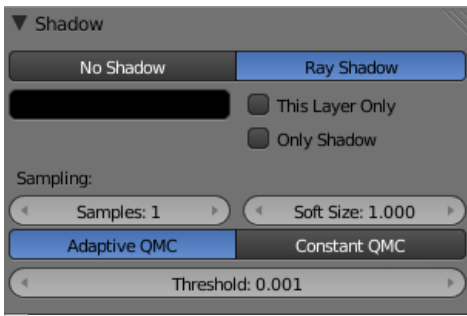
Sky & Atmosphere Panel



Sky & Atmosphere panel

Various settings for the appearance of the sun in the sky, and the atmosphere through which it shines, are available. For details, see [Sky and Atmosphere](#).

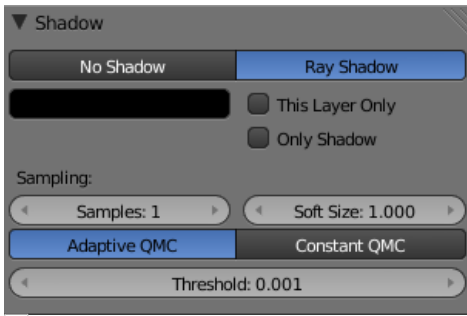
Shadow Panel



Shadow panel

When a Sun light source is selected the Shadow and Spot panel has the following default layout:

Sun Raytraced Shadows



Shadow panel

The Sun light source can only cast raytraced shadows. It shares with other lamp types the same common shadowing options, described in [Shadows Properties](#).

The raytraced shadows settings of this lamp are shared with other ones, and are described in [Raytraced Properties](#).

Hints

A Sun lamp can be very handy for a uniform clear day-light open-space illumination.

moved to [Doc:2.5/Manual/Lighting/Lamps/Sun?](#)

Page status ([reviewing guidelines](#))

Images

The second image is from 2.4

Proposed fixes: none

Sun: Sky & Atmosphere

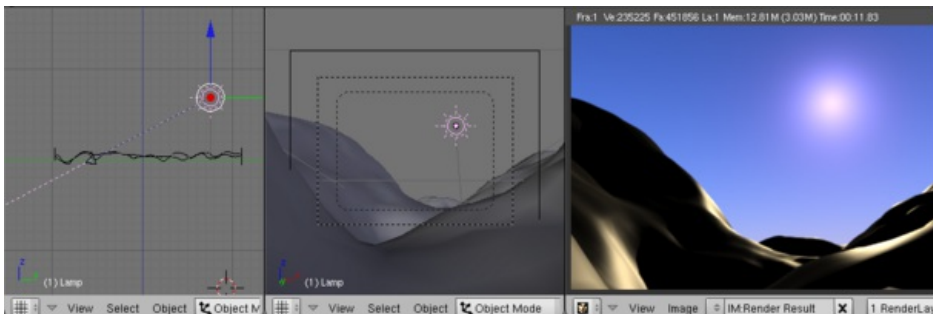


Sky & Atmosphere panel

This panel allows you to enable a new effect that simulates various properties of real sky and atmosphere: the scattering of the sun light as it crosses the kilometers of air overhead. For example, when the Sun is high, the sky is blue (and the horizon, somewhat whitish). When the Sun is near the horizon, the sky is dark blue/purple, and the horizon turns orange. The dispersion of the atmosphere is also more visible, when it is a bit foggy: the more away an object is, the more “faded” in light grey it is... Go out in the countryside, a nice hot day, you will see.

To enable this effect, you have to use a Sun light source. If, as usual, the *position* of the lamp has no importance, its *rotation* is crucial: it determines which hour it is. As a start point, you should reset rotation of your Sun (with AltR, or typing **0** in each of the three Rotation fields X/Y/Z in the Transform Properties panel – N). This way, you’ll have a nice mid-day sun (in the tropics).

Now, there are two important angles for the Sky/Atmosphere effect: the “incidence” angle (between light direction and X-Y plane), which determine the “hour” of the day (as you might expect, default rotation – straight down – is “mid-day”, a light pointing straight up is “mid-night”, and so on...). And the rotation around the Z axis determines the position of the sun around the camera.



The dashed “light line” of the Sun lamp crossing the camera focal point.

In fact, to have a good idea of where the sun is in your world, relative to the camera in your 3D view, you should always try to have the dashed “light line” of the lamp crossing the center of the camera (its “focal” point), as shown in (*The dashed “light line” of the Sun lamp crossing the camera focal point*). This way, in camera view (0 NumPad, center window in the example picture), you will see where will be the “virtual” sun created by this effect.

It is important to understand that the *position* of the sun has no importance for the effect: only its *orientation* is relevant. The position might just help you in your scene design.

Options

Sun & Sky Presets

- Classic:
- Desert:
- Mountain:

Sky

Sky

This button enables the sky settings: it will create a “sky”, with a “sun” if visible, and mix it with the background as defined in World settings.

Turbidity

This is a general parameter that affects sun view, sky and atmosphere, it's an atmosphere parameters that low values describe clear sky, and high values shows more foggy sky. In general, low values give clear, deep blue sky, with “little” sun; high values give more reddish sky, with a big halo around the sun. Note that this parameter is one which can really modify the “intensity” of the sun lighting. See examples below.

Here are its specific controls:

Blending

- The first drop-down list shows you a menu of various mix methods. The one selected will be used to blend the sky and sun with the background defined in the World settings. The mixing methods are the same as described e.g. in the [Mix Compositing Node](#) page.
- Factor

Controls how much the sky and sun effect is applied to the World background.

Color space

These buttons allows you to select which color space the effect uses, with following choices:

- CIE
- REC709
- SMPTE
- Exposure

This numeric field allows you to modify the exposition of the rendered Sky and Sun (**0.0** for no correction).

Horizon

- Brightness

Controls brightness of colors at the horizon. Its value should be in the range **0.0** to **10.0**, values near zero means no horizontal brightness, and large values for this parameter increase horizon brightness. See examples below.

- Spread

Controls spread of light at the horizon. Its value should be in the range **0.0** to **10.0**, low values in the range result in less spread of light at horizon, and high values in the range result all horizon light spread in sky.

Sun

- Brightness

Controls the sun brightness. Its value should be in the range **0.0** to **10.0**, with low values the sky has no sun and with high values the sky only has sun.

- Size

Controls the size of sun. Its values should be in the range **0.0** to **10.0**, but note that low values result in large sun size, and high values result in small sun size. Note that the overall brightness of the sun remains constant (set by Brightness), so the larger the sun (the smaller Size), the more it “vanishes” in the sky, and *vice-versa*.

- Back Light

For “Back Scatter Light”, result on sun's color, high values result on more light around the sun. Its values range is **-1.0** to **1.0**. Negative values result on no more light around sun.

Atmosphere

Atmosphere

This button enables the atmosphere settings. It will not modify the background, but it tries to simulate the effects of an atmosphere: scattering of the sun light in the atmosphere, its attenuation, ...

Intensity

- Sun

Sets sun intensity. Its values are in range **0.0** to **10.0**. High values result more blue light in far objects.

- Distance

This factor is used to convert Blender units into an understandable unit for atmosphere effect, it starts from **0** and high values result in more yellow light into the scene.

Scattering

- Inscattering

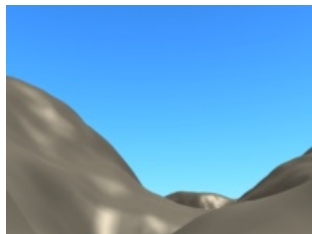
This factor can be used to decrease the effect of light inscattered into atmosphere between camera and objects in scene. This value should be **1.0** but can be changed to get in some nice, but not realistic, images.

- Extinction

This factor can be use to decrease the effect of extinction light from objects in the scene. Like Inscattering factor, this parameter should be **1.0** but you can change it, low values result in less light extinction. Its value is in the range **0.0** to **1.0**.

Examples

First, let's see what happens when we modify the orientation of the sun:



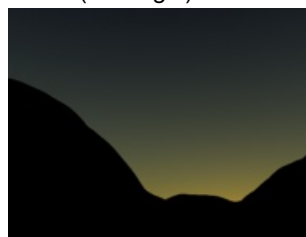
☐ With sun right overhead (mid-day).



☐ With sun deep "under the Earth" (mid-night).



☐ Sun slightly above the horizon (start of twilight).



☐ Sun slightly below the horizon (end of twilight).

Variations in Sun orientation, Sun Size to **5.0**, all other settings to default.

[The 2.4 .blend file of these examples.](#)

And now, the effects of various settings (examples created with [this 2.4 .blend file](#)):



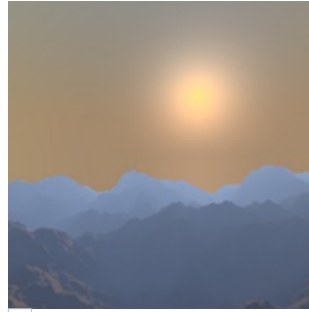
Turbidity: **2.0**.



Turbidity: **2.3**.



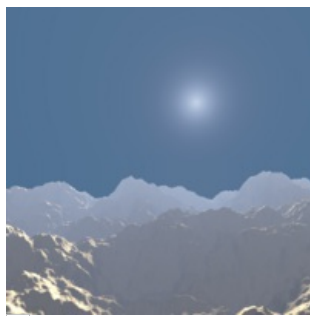
Turbidity: **5.0**.



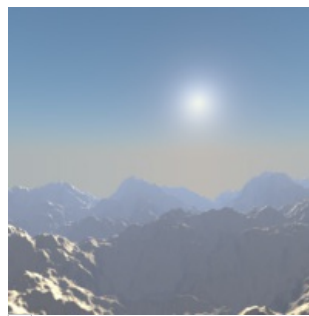
Turbidity: **10.0**.

Variations in Turbidity parameter, all other settings to default.

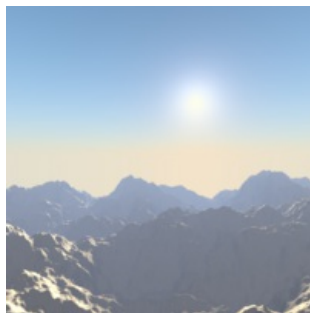
Sky



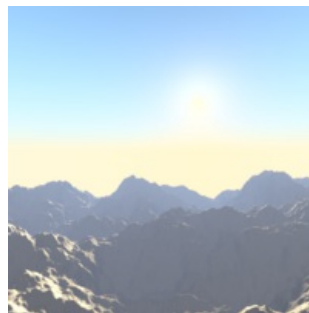
Horizon Brightness: **0.0**.



Horizon Brightness: **0.85**.

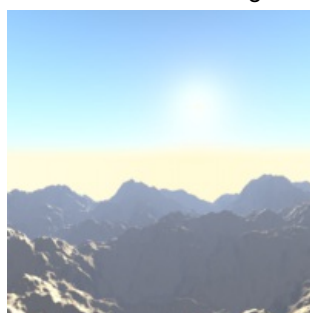


Horizon Brightness: **1.04**.

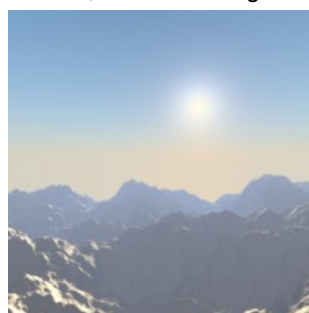


Horizon Brightness: **1.13**.

Variations in Horizon Brightness parameter, all other settings to default.



Horizon Spread: **0.7**.



Horizon Spread: **1.2**.



☐ Horizon Spread: **2.2.**

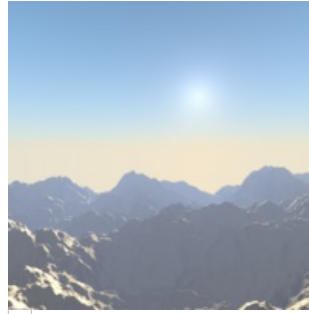


☐ Horizon Spread: **5.0.**

Variations in Horizon Spread parameter, all other settings to default.



☐ Sun Brightness: **0.2.**



☐ Sun Brightness: **0.5.**

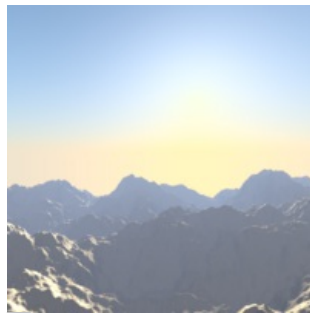


☐ Sun Brightness: **0.75.**

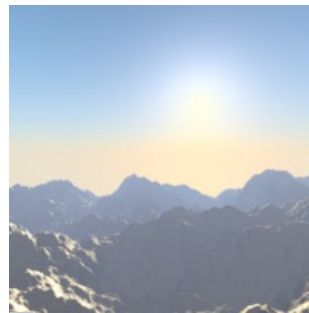


☐ Sun Brightness: **1.0.**

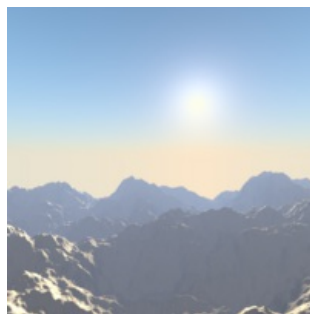
Variations in Sun Brightness parameter, all other settings to default.



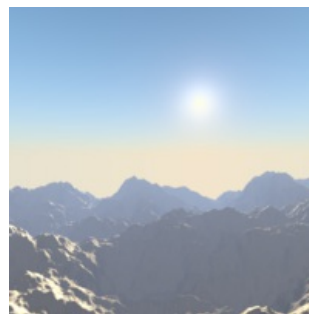
☐ Sun Size: **2.0.**



☐ Sun Size: **4.0.**



☐ Sun Size: **7.0.**



☐ Sun Size: **10.0.**

Variations in Sun Size parameter, all other settings to default.



☐ Back Light: **-1.0.**



☐ Back Light: **-0.33.**



☐ Back Light: **0.33.**

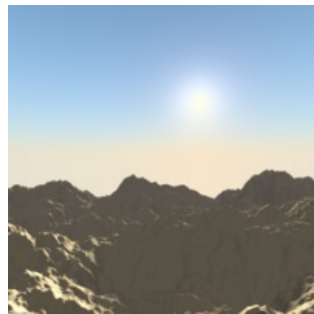


☐ Back Light: **1.0.**

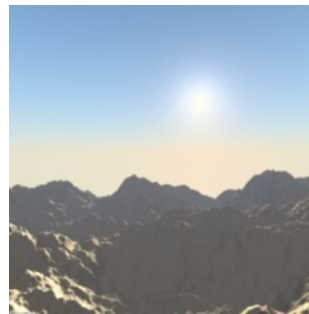
Variations in Back Light parameter, Sun Bright to **2.5**, all other settings to default.

Atmosphere

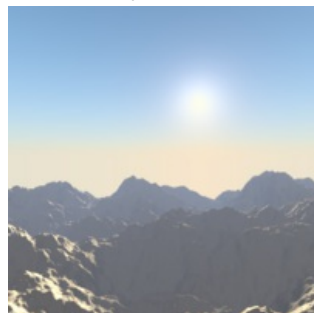
For all renders below, Hor.Bright is set to **0.2**, and Sun Bright to **2.0**.



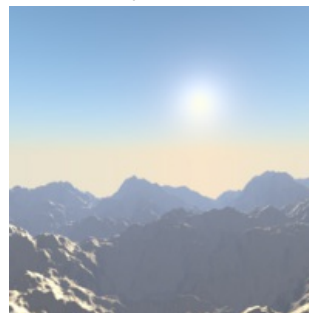
☐ Sun Intensity: **1.0.**



☐ Sun Intensity: **3.33.**

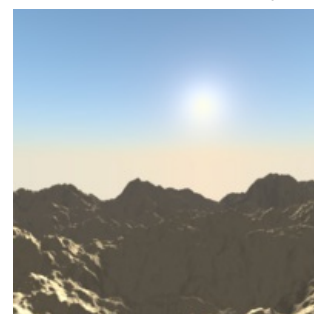


☐ Sun Intensity: **6.66.**

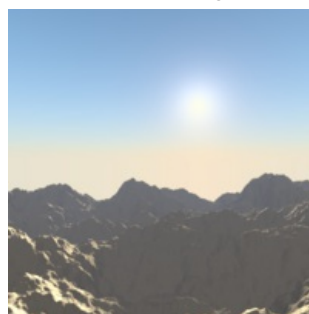


☐ Sun Intensity: **10.0.**

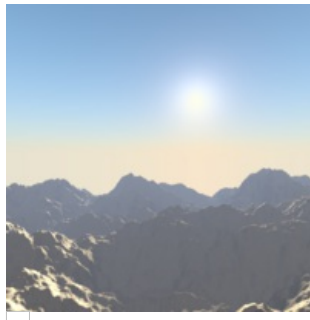
Variations in Sun Intensity parameter, all other settings to default.



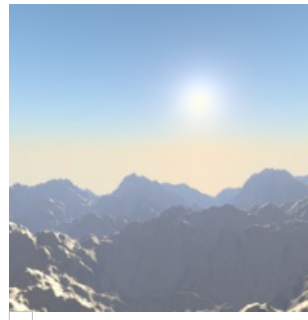
☐ Inscattering: **0.1.**



☐ Inscattering: **0.33.**

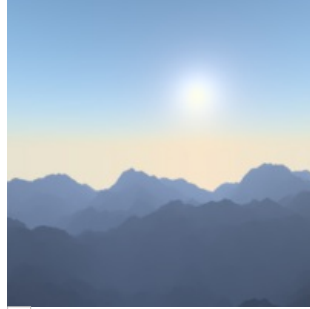


Inscattering: **0.66**.



Inscattering: **1.0**.

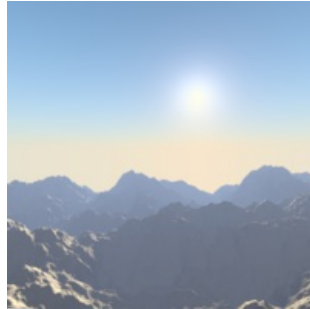
Variations in Inscattering parameter, all other settings to default.



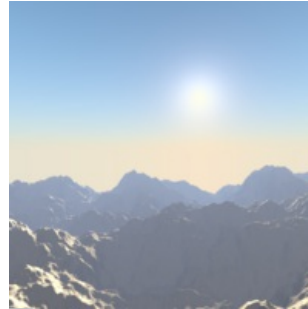
Extinction: **0.0**.



Extinction: **0.33**.

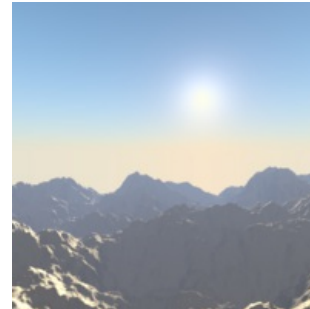


Extinction: **0.66**.

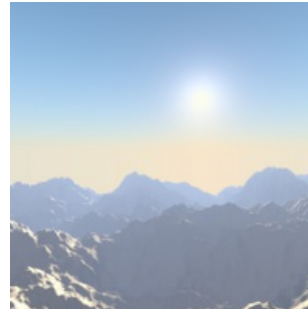


Extinction: **1.0**.

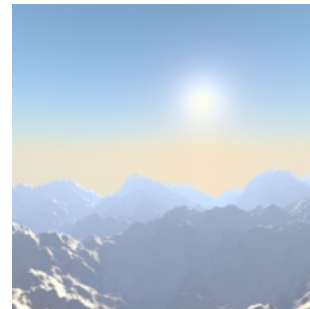
Variations in Extinction parameter, all other settings to default.



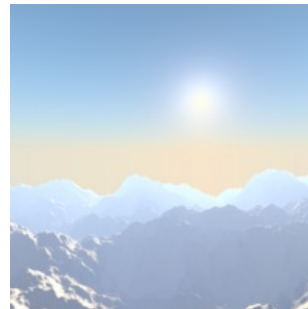
Distance: **1.0**.



Distance: **2.0**.



Distance: **3.0**.



Distance: **4.0**.

Variations in Distance parameter, all other settings to default.

Hints and limitations

To always have the Sun pointing at the camera center, you can use a [TrackTo constraint](#) on the sun object, with the camera as target, and -Z as the “To” axis (use either X or Y as “Up” axis). This way, to modify high/position of the sun in the rendered picture, you just have to move it, orientation is automatically handled by the constraint. Of course, if your camera itself is moving, you should also add e.g. a [Copy Location constraint](#) to your Sun lamp, with the camera as target – and the Offset option activated... This way, the sun light won't change as the camera moves around.

If you use the default Add mixing type, you should use a very dark-blue world color, to get correct “nights”...

This effect works quite well with a Hemi lamp, or some ambient occlusion, to fill-in the Sun shadows.

Atmosphere shading currently works incorrectly in reflections and refractions and is only supported for solid shaded surfaces. This will be addressed in a later release.

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Void page

Proposed fixes: none

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Partial page

Proposed fixes: none

Environment Lighting

Environment light provides light coming from all directions. Light is calculated with a raytraced method which is the same as that used by Ambient Occlusion. The difference is that Environment lighting takes into account the "ambient" parameter of the material shading settings, which indicates the amount of ambient light/color that material receives. Also, you can choose the environment color source (white, sky color, sky texture) and the light energy.

Try to use both settings simultaneously to achieve better global lighting.

It's good for mimicking the sky in outdoor lighting. Environment lighting can be fairly noisy at times.

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Lighting/Ambient_Light"

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Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Ambient Occlusion

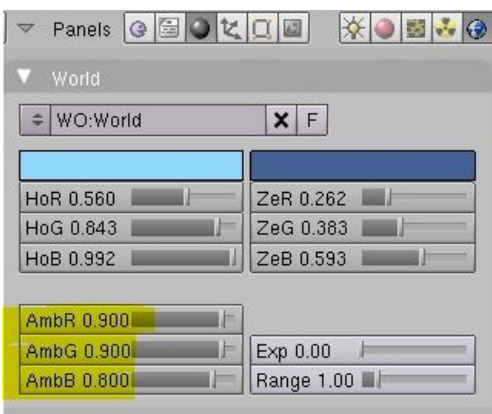
Ambient Occlusion is a sophisticated raytracing calculation which simulates soft global illumination shadows, by faking darkness perceived in corners and at mesh intersections, creases, and cracks, where ambient light is occluded, or blocked.

There is no such thing as AO in real life, AO is a specific not-physically-accurate (but generally nice looking) rendering trick. It basically samples a hemisphere around each point on the face, sees what proportion of that hemisphere is occluded by other geometry, and shades the pixel accordingly.

It's got nothing to do with light at all, it's purely a rendering trick that tends to look nice because generally in real life surfaces that are close together (like small cracks) will be darker than surfaces that don't have anything in front of them, because of shadows, dirt, etc.

The AO process though is approximating this result, it's not simulating light bouncing around or going through things. That's why AO still works when you don't have any lights in the scene, and it's why just switching on AO alone is a very bad way of "lighting" a scene.

You must have raytracing enabled as a Render panel option in the Shading section for this to work.



The World panel with ambient color sliders highlighted.

You must have an ambient light color set to your desires. By default, the ambient light color (world) is black, simulating midnight in the basement during a power outage. Applying that color as ambient will actually darken all colors. A good outdoor mid-day color is RGB (0.9, 0.9, 0.8) which is a whitish yellow sunny kind of color on a bright-but-not-harshly-bright day.

Options



The Amb Occ panel, method selection.

Factor

The strength of the AO effect, a multiplier for addition or subtraction.

Ambient Occlusion is composited during the render. Three blending modes are available:

Add

The pixel receives light according to the number of non-obstructed rays. The scene is lighter. This simulates global illumination.

Multiply

Ambient occlusion is multiplied over the shading, making things darker.

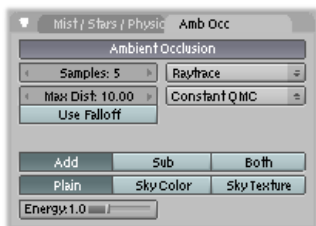
Note

If Multiply is chosen, there must be other light sources, otherwise the scene will be pitch black. In the other two cases the scene is lit even if no explicit light is present, just from the AO effect. Although many people like to use AO alone as a quick shortcut to light a scene, the results it gives will be muted and flat, like an overcast day. In most cases, it is best to light a scene properly with Blender's standard lamps, then use AO on top of that, set to "Multiply", for the additional details and contact shadows.

The Gather panel contains settings for the ambient occlusion quality. Note that these settings also apply to Environment Lighting and Indirect Lighting.

Ambient occlusion has two main methods of calculation: Raytrace and Approximate.

Raytrace

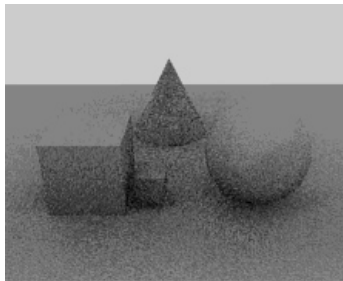


The Amb Occ panel, Raytrace method.

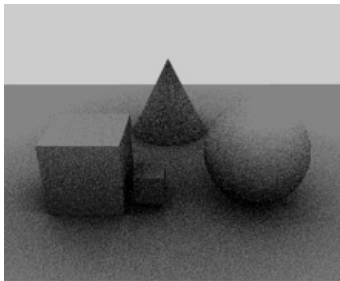
The Raytrace method gives the more accurate, but also the more noisy results. You can get a nearly noiseless image, but at the cost of render time... It is the only option if you want to use the colors of your sky's texture.

Samples

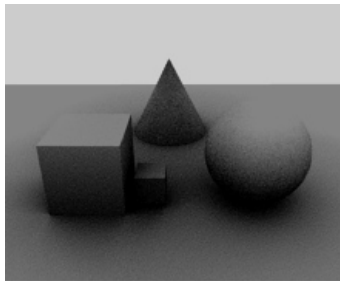
The number of rays used to detect if an object is occluded. Higher numbers of samples give smoother and more accurate results, at the expense of slower render times. The default value of **5** is usually good for previews. The actual amount of shot rays is the square of this number (i.e. Samples at **5** means **25** rays). Rays are shot at the hemisphere according to a random pattern (determined by the sample methods described above), this causes differences in the occlusion pattern of neighboring pixels unless the number of shot rays is big enough to produce good statistical data.



Ambient Occlusion with **3** Samples.

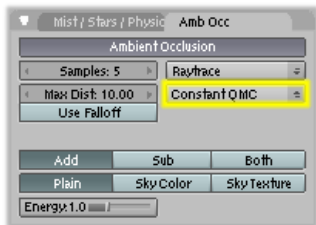


Ambient Occlusion with **6** Samples.



Ambient Occlusion with **12** Samples.

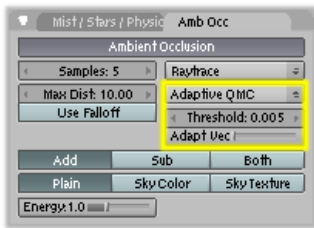
You have the three standard sampling options:



Constant QMC sampling.

Constant QMC

The base Quasi-Monte Carlo, gives evenly and randomly distributed rays.



Adaptive QMC sampling.

Adaptive QMC

An improved version of QMC, that tries to determine when sample can be lowered or skipped, based on its two settings:

Threshold

The limit below which the sample is considered fully occluded ("black") or un-occluded ("white"), and skipped.

Adapt to Speed

A factor to reduce AO sampling on fast moving pixels. As it uses the Vec render pass, this one must be enabled (see [render passes page](#)).

About QMC

See also the [raytraced shadows page](#) for more info about Qausi-Monte Carlo sampling method.

Constant Jittered

The historical sample method, more prone to "bias" artifacts...

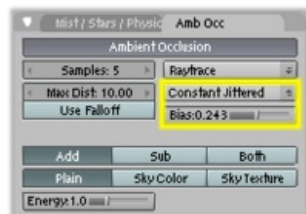
Bias

The angle (in radians) the hemisphere will be made narrower (i.e. the hemisphere will be no more a real hemisphere: its section will be no more a semicircle, but an arc of a circle of " $\pi - \text{Bias}$ " radians).

The bias setting allows you to control how smooth "smooth" faces will appear in AO rendering. Since AO occurs on the original faceted mesh, it is possible that the AO light makes faces visible even on objects with "smooth" on. This is due to the way AO rays are shot, and can be controlled with the Bias slider. Note that even if it might happens with QMC sampling methods, this is much more visible with the Constant Jittered one – and anyway, you have no Bias option for QMC...

Attenuation

The length of the occlusion rays. The longer this distance, the greater impact that far away geometry will have on the occlusion effect. A high Distance value also means that the renderer has to search a greater area for geometry that occludes, so render time can be optimized by making this distance as short as possible, for the visual effect that you want.

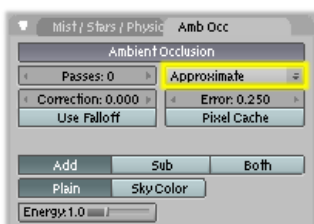


☐ Constant Jittered sampling.

☐ 24x24 UV Sphere with Bias: **0.05** (default). Note the facets on the sphere's surface even though it is set smooth.

☐ Raising the Bias to **0.15** removes the faceted artifacts.

Approximate



The Amb Occ panel, Approximate method.

The Approximate method gives a much smoother result for the same amount of render time, but as its name states, it is only an

approximation of the Raytrace method, which implies it might produce some artifacts – and it cannot use the sky's texture as base color

This method seems to tend to “over-occlude” the results. You have two complementary options to reduce this problem:

Passes

Set the number of pre-processing passes, between **0** (no pre-processing) to **10**. Keeping the pre-processing passes high will increase render time but will also clear some artifacts and over-occlusions.

Error

This is the tolerance factor for approximation error (i.e. the max allowed difference between approximated result and fully computed result). The lower, the slower the render, but the more accurate the results... Ranges between **0.0** and **10.0**, defaults to **0.250**.

Pixel Cache

When enabled, it will keep values of computed pixels, to interpolate it in its neighbors. This speeds up further more the render, generally without visible loss in quality...

Correction

A correction factor to reduce over-occlusion. Ranges between **0.0** (no correction) to **1.0**.

Common Settings

Falloff

When activated, the distance to the occluding objects will influence the “deepness” of the shadow. This means that the further away is an occluding geometry, the lighter will be its “shadow”. This effect only occurs when the Strength factor is higher than **0.0**. It mimics the light dispersion in the atmosphere...

Strength

Controls the attenuation of the shadows enabled with Use Falloff. Higher values give a shorter shadow, as it falls off more quickly (corresponding to a more foggy/dusty atmosphere). Ranges from **0.0** (default, no falloff) to **10.0**.

Technical Details

Ambient occlusion is calculated by casting rays from each visible point, and by counting how many of them actually reach the sky, and how many, on the other hand, are obstructed by objects.

The amount of light on the point is then proportional to the number of rays which have “escaped” and have reached the sky. This is done by firing a hemisphere of shadow-rays around. If a ray hits another face (it is occluded) then that ray is considered “shadow”, otherwise it is considered “light”. The ratio between “shadow” and “light” rays defines how bright a given pixel is.

Hints

Ambient occlusion is a raytracing technique (at least with Raytrace method), so it tends to be slow. Furthermore, performance severely depends on octree size, see the [rendering chapter](#) for more information.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Lighting/Indirect_Lighting"

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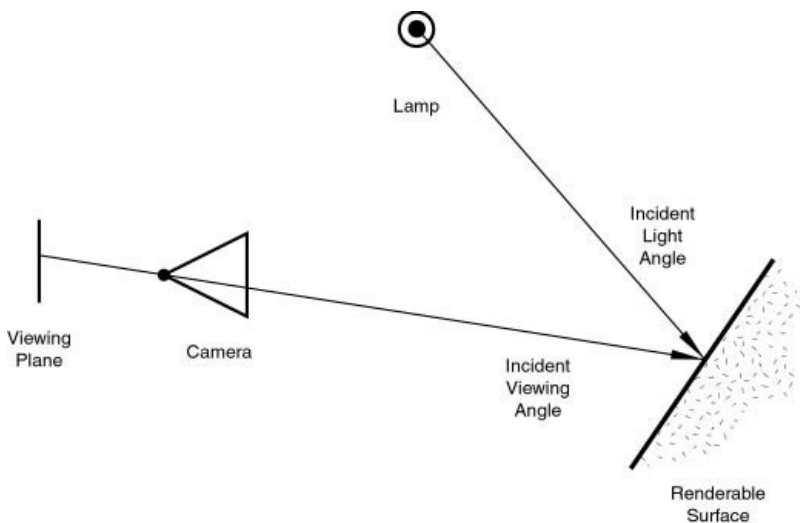
Introduction to Materials

Before you can understand how to design effectively with materials, you must understand how simulated light and surfaces interact in Blender's rendering engine and how material settings control those interactions. A deep understanding of the engine will help you to get the most from it.

The rendered image you create with Blender is a projection of the scene onto an imaginary surface called the *viewing plane*. The viewing plane is analogous to the film in a traditional camera, or the rods and cones in the human eye, except that it receives simulated light, not real light.

To render an image of a scene we must first determine what light from the scene is arriving at each point on the viewing plane. The best way to answer this question is to follow a straight line (the simulated light ray) backwards through that point on the viewing plane and the focal point (the location of the camera) until it hits a renderable surface in the scene, at which point we can determine what light would strike that point.

The surface properties and incident light angle tell us how much of that light would be reflected back along the incident viewing angle (*Rendering engine basic principle*).



Rendering engine basic principle.

Two basic types of phenomena take place at any point on a surface when a light ray strikes it: diffusion and specular reflection. Diffusion and specular reflection are distinguished from each other mainly by the relationship between the incident light angle and the reflected light angle.

The shading (or coloring) of the object during render will then take into account the base color (as modified by the diffusion and specular reflection phenomenon) and the light intensity

Using the internal raytracer, other (more advanced) phenomena could occur. In raytraced reflections, the point of a surface struck by a light ray will return the color of its surrounding environment, according to the rate of reflection of the material (mixing the base color and the surrounding environment's) and the viewing angle.

On the other hand, in raytraced refractions, the point of a surface stroke by a light ray will return the color of its background environment, according to the rate of transparency (mixing the base color and the background environment's along with its optional filtering value) of the material and the optional index of refraction of the material, which will distort the viewing angle.

Of course, shading of the object hit by a light ray will be about mixing all these phenomena at once during the rendering. The appearance of the object, when rendered, depends on many inter-related settings:

- World (Ambient color, Radiosity, Ambient Occlusion)
- Lights
- Material settings (including ambient, emission, and every other setting on every panel in that context)
- Texture(s) and how they are mixed
- Material Nodes
- Camera
- viewing angle
- obstructions and transparent occlusions
- shadows from other opaque/transparent objects
- Render settings
- Object dimensions (SS settings are relevant to dimensions)
- Object shape (refractions, fresnel effects)

Shaders

Materials can have a wide array of properties. It is the combination of all of these things that define the way a material looks, and how a shader will behave when rendered.

Diffuse Shading

The first step is to add diffuse shading information. Diffuse shading is observed on matte and semi matte objects, or surfaces that lack highlights. It represents the microscopic variations in a surface that scatter incoming light in a very broad range of angles.

Specular Shading

In CG you can make objects appear shiny by adding specular. Specularity represents the reflections of bright objects hitting a surface. It is important to note, that typically, specular highlights are not actually the reflections of lights. Since lights are usually much brighter than the surrounding environment, we can fake these reflections with specular highlights.

Reflectivity

To see the actual reflections of surrounding objects, shaders can be reflective, using a technique called raytracing. Raytracing casts virtual rays from the camera, and traces where they end up after bouncing off objects that have reflectivity. Not all reflections are perfectly glossy, as in a mirror or a chrome ball. Shaders can simulate non-glossy reflections, which blur the reflected image. This is expensive for render engines, since it involves a lot of computation

Transparency

Many surfaces are transparent, or semi transparent. A shader can create transparency by simply lowering its opacity, allowing objects behind to see through, however this is rarely how transparent objects appear. Transparency can utilize raytracing as well. Most transparent objects cause refraction, which is the bending of light rays as they pass through objects of differing indexes of refraction. Just fill a glass with water to see refraction in action. Transparency can also be blurred, as in frosted glass, or some plastic containers. Blurry refractions, just like blurry reflections, are CPU intensive.

Translucency

If a material is able to let light through, but it scatters so much that blurred transparency is not practical, shaders can simulate translucency. For thin objects, translucency is good for things like leaves, paper, or flowers. In cg, translucency works by calculating the shading on the back side of a surface, and passing on to the other side. For thicker objects, you will want to use subsurface scattering

Subsurface Scattering

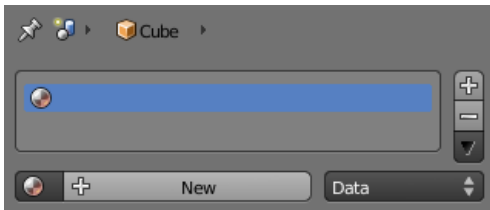
Subsurface scattering, or sss, is an effect that can simulate organic materials, where light is able to penetrate the surface, but bounces and scatters under the surface, and exits in a different place. This is typical in things like human skin, candles, cheese, grapes, marble, etc. SSS can add a great deal of quality and realism to materials, but it can be expensive for the renderer.

Incandescence


Some objects are, or have the appearance of being a light source, such as a light bulb or a tv screen. This can be achieved by decreasing the amount of shading information.

In this section we look at how to set up the various material parameters in Blender, and what you should expect as a result. We also give hints about practical material usage.

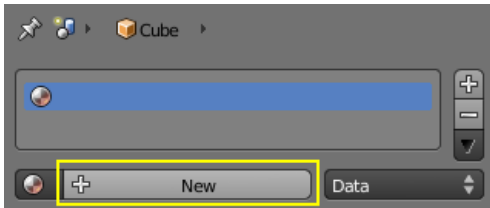
Creating a new Material



Material menu.

Every time a new Object is created it has no material linked to it. By clicking on , you switch to the Shading context and the Material Buttons window appears. This window should be almost empty at this point.

Adding a new material is done with the menu button shown in *Add newmaterial..* The following options are available:



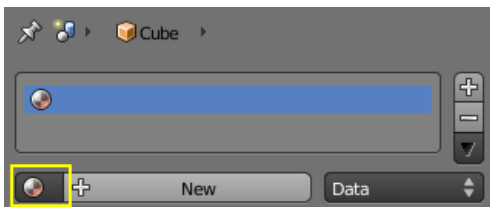
Add new material.

Add New

Add a new material and link it to the active object or object data. Like other datablocks, Blender will automatically set its name to Material.001 and so on.

It's a very good idea to give your materials clear names so you can keep track of them, especially when they're linked to multiple objects.

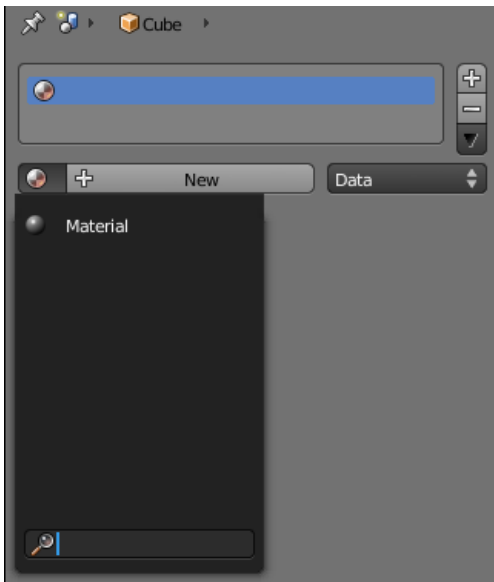
Sharing a Material from another object



Select an existent material.

Select an existing material

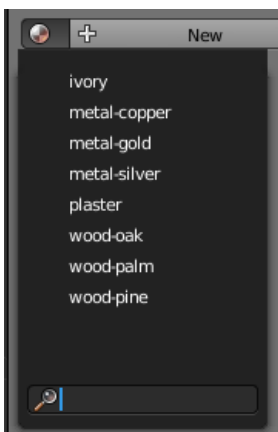
Choose an existing material from a list.



Existent material drop down menu

Blender is built to allow you to reuse *anything*, including material settings, between many objects. Instead of creating duplicate materials, you can simply re-use an existing material. There are two ways to do this:

- With the mesh selected, click the sphere located to the left of the Material name. The popup list shows you all the current materials. To use one, just click on it.



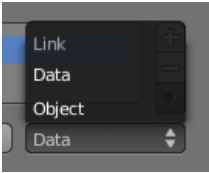
List of available materials



Filtered list

- New to 2.5 is the search field at the bottom of the material list. By entering, for example, "wood" all existent materials are filtered so that only materials containing "wood" are displayed in the list.
- In the 3D View, with CtrlL you can quickly link all selected objects to the material (and other aspects) of the [active object](#). Very useful if you need to set a large number of objects to the same material; just select all of them, then the object that has the desired material, and CtrlL link them to that "parent".

Linking material to object or object's data



Link material to object or to object's data

A material can be linked to either the object or to the object's data.

If a material is linked to the Data, all other objects using the same data(ObData)will share the same material. But if it is linked to the object instead, the material is specific to that object only. This is helpful if you are using linked duplicates(Alt + D). This is confusing but it is an important topic, for more [click here](#).

Materials Options

Once the object has at least one material linked to it, many new panels are readily displayed to allow you to precisely control the shading of the material. Using each of these panels is discussed in the [next section](#).

The [preview panel](#) attempts to show you what the shader will produce for different kinds of geometric basic shapes. Depending on your buttons window layout, some panels may be collapsed.

Material Preview

Mode: All Modes

Panel: Shading/Material Context → Preview

Description

The Preview panel gives a quick visualisation of the active material and its properties, including its Shaders, Ramps, Mirror Transp properties and Textures. It provides many useful shapes that are very useful for designing new shaders: for some shaders (like those based Ramp colors or a Diffuse shader like Minnaert), one needs fairly complex or specific previewing shapes to decide if the shader-in-design achieves its goal.

Options

Flat XY plane

Useful for previewing textures and materials of flat objects, like walls, papers and such.

Sphere

Useful for previewing textures and materials of sphere-like objects, but also to design metals and other reflective/transparent materials, thanks to the checkered background.

Cube

Useful for previewing textures and materials of cube-like objects, but also to design procedural textures. Features a checkered background.

Monkey

Useful for previewing textures and materials of organic or complex non-primitive shapes. Features a checkered background.

Hair strands

Useful for previewing textures and materials of strand-like objects, like grass, fur, feathers and hair. Features a checkered background.

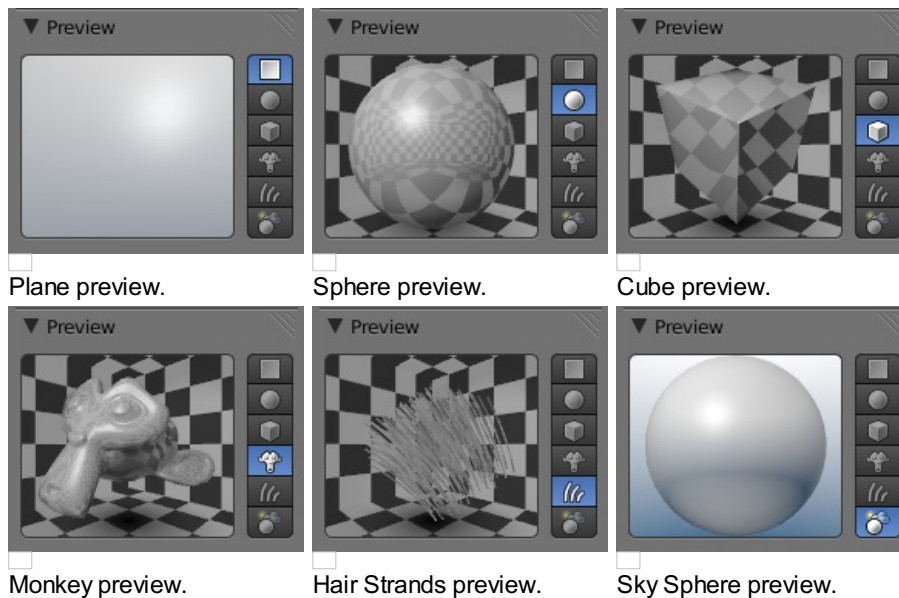
Large Sphere with Sky

Useful for previewing textures and materials of sphere-like objects, but also to design metals and other reflective materials, thanks to the gradient Sky background.

Preview uses OSA (oversampling)

Whatever the preview option, it will make use of OSA (oversampling) in order to provide with a better quality. Disable this option if your computer is already slow or old.

Examples



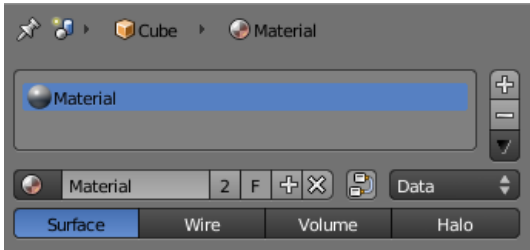
Materials

Mode: All Modes

Panel: Shading/Material Context → Material

Materials can be linked to objects and Object's data in the materials panel, of the Shading/Material context. Here is where you can manage how materials are linked to objects, meshes, etc. and activate a material for editing in the rest of the panels.

Context

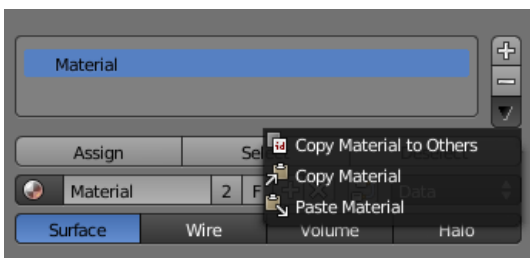


Material added in object mode

At the top of the material menu a list of icons explains the context in which the material is being edited. In the example above, the material Material is linked to the object Cube which is linked to the scene Scene.

By toggling the pin symbol on the left side on and off, Blender can be told to display only the selected material or to follow context.

Material slots



Copy and paste dropdown menu

With a material linked or created, one or several material slots can be created and further options become available:

- + sign
Add a new material slot or copy the one selected
- - sign
Remove selected material slot
- Down arrow
Copy and paste the selected material slot

Multiple materials

Meshes can handle having more than one material. Materials can be mapped on a per-face basis, as detailed on the [Multiple Materials](#) page. In edit mode, the following tools appear:

- Assign
Assign the material in the selected material slot to selected vertices
- Select
Select vertices assigned to the selected material slot
- Deselect
Deselect vertices assigned to the selected material slot

Material naming and linking

Material's name field

click into this field to rename your material

Number of users (number field)

The number of objects or object's data that use the material. This material is linked between the various objects, and will update across all of them when edited. Clicking this number will make a 'single user copy', duplicating the material, with it linked only to the active object/object's data.

F (Fake user)

Gives the material a 'fake user', to keep the material datablock saved in the .blend file, even if it has no real users.

Plus sign

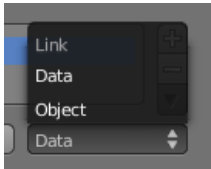
Add a new material.

X sign

Remove link to this material.

Nodes

Designates this material to be a material node noodle, and not from the Material/Ramps/Shaders settings.



Link material to object or to object's data

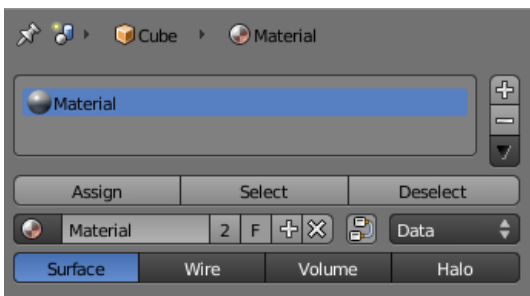
Datablock links

The Link pop-up menu has two choices, Data and Object. These two menu choices determine whether the material is linked to the object or to the data, (in this case) the mesh (or curve, nurbs, etc.). The Data menu item determines that this material will be linked to the mesh's datablock which is linked to the object's datablock. The Object menu item determines that the material will be linked to the object's data block directly.

This has consequences of course. For example, different objects may share the same mesh datablock. Since this datablock defines the shape of the object any change in edit mode will be reflected on all of those objects. Moreover, anything linked to that mesh datablock will be shared by every object that shares that mesh. So, if the material is linked to the mesh, every object will share it.

On the other hand, if the material is linked directly to the object datablock, the objects can have different materials and still share the same mesh. Short explanation: If connected to the object, you can have several instances of the same obData using different materials. If linked to mesh data, you can't.

Material type



Material added in edit mode

These toggles tell Blender where this material fits into the Render Pipeline, and what aspects of the material are to be rendered.

Surface

Render object as a surface

Wire

Render the edges of faces as wires (not supported in ray tracing)

Volume

Render object as a volume. See [Volumes](#)

Halo

Render object as halo particles. See [Halos](#)

Material Properties Overview

The usage of each section of the material properties are detailed in the next section.

Surface and Wire materials

Surface material types are the most common materials. They represent objects with a defined surface.

Wire materials simply turn all of an object's edges into rods, which then become renderable, but uses the same shading options as surface materials.

[Preview](#)

This is a preview of the current material mapped on to one of several objects.

- Flat Plane
- Sphere
- Cube
- Monkey
- Strands
- Large Sphere with Sky

[Diffuse](#)

Diffuse shading simulates light hitting a surface and bouncing off in a very wide angle. You can set the color of the diffuse shading, and set what model is used for the diffuse calculation.

[Specular](#)

Specularity simulates reflections of light sources, that are often sharp, bright spots. You can set the color of the specular shading, and set what model is used for the specular calculation.

Shading

- Emit
Adds extra illumination, as if the material is glowing.
- Ambient
Sets the global ambient light the material receives
- Translucency
Amount of shading on the back side that shows through. Use to simulate thin objects, like leaves or paper.
- Shadeless
This disables the calculation of any shading, so only color information is visible. This is essentially makes it a "surface shader"
- Tangent Shading
Use the material's tangent vector instead of the normal for shading — for anisotropic shading effects (e.g. soft hair and brushed metal). This shading was introduced in 2.42, see also settings for strand rendering in the menu further down and in the Particle System menu.
- Cubic Interpolation
Use cubic interpolation for diffuse values, for smoother transitions between light areas and dark areas

[Transparency](#)

Set options for objects in which light can pass through

[Mirror](#)

Here you can set options for materials that are reflective

[Subsurface Scattering](#)

Subsurface scattering simulates semi translucent objects in which light enters, bounces around, then exits in a different place. Examples are candles, human skin, cheese, etc.

[Strand](#)

These settings are used when rendering the material on fur or hair

Options

- Traceable
Allows material to be calculated raytracing, for reflections and refractions.
- Full Oversampling
Forces material to render full shading and textures for all Anti-Aliasing Samples.
- Sky
Renders material with no alpha, replacing the background with the sky
- Use Mist
Uses Mist with this material.
- Invert Z Depth
Renders materials faces with an inverted Z buffer.
- Z Offset
If using Invert Z Depth, this is an artificial offset to z values.
- Light Group
Limit material's lighting calculation to a specific light group
- Exclusive
Material uses light group exclusively
- Face Textures
Replaces object's base color with color from face assigned image textures.
- Face Textures Alpha
Replaces object's base alpha value with alpha from face assigned image textures.
- Vertex Color Paint
Replaces object's base color with vertex colors.
- Vertex Color Light
Adds vertex color as additional light.
- Object Color
Modulate the result with a per object color.

Shadow

- Receive
Allows the material to receive shadows cast by other objects
- Receive Transparent
Allows material to receive transparent shadows cast by other transparent objects.
- Cast Only
Causes objects with the material to only cast a shadow, and not appear in renders.
- Casting Alpha
Sets the Alpha of shadow casting. Used for irregular and deep shadow buffering.
- Shadows Only
Renders shadows as materials alpha value, making materials transparent, except for shadowed areas.

- Shadow Only Type

Set the type of shadows used when Shadows Only is enabled

- Shadow and Distance
- Shadow Only
- Shadows and Shading

- Cast Buffer Shadow

Allows material to cast shadows from buffer lamps.

- Buffer Bias

Factor to multiply shadow buffer by.

- Auto Ray Bias

Prevents raytraced shadow errors on surfaces with smooth normals

- Ray Bias

Shadow raytracing bias value to prevent terminator artifacts on shadow boudary.

- Cast Approximate

Allow material to cast shadows when using Approximate Ambient Occlusion}}

Volume Material

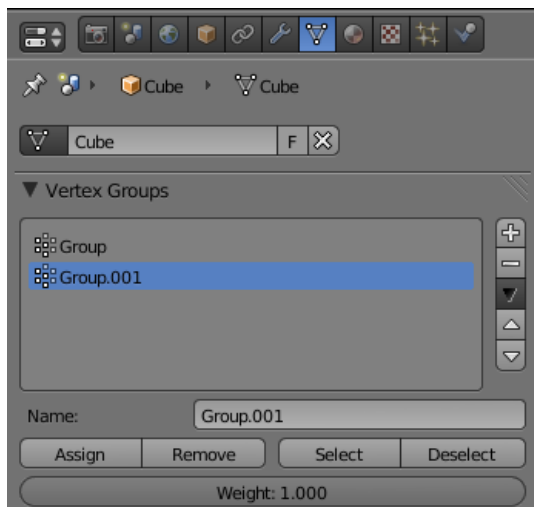
Volume materials represent volumes of tiny particles, like clouds or smoke. They are very different from standard materials, but are detailed in the [Volume Page](#).

Halo Material

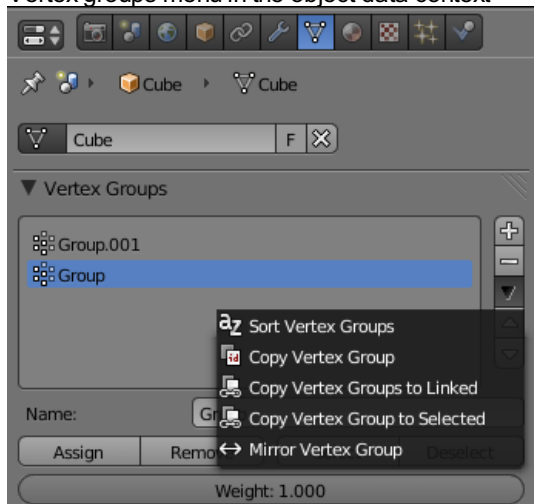
Halo materials renders each of the objects points as glowing dots. This is a useful material for simulating particle effects or lens flares. They are detailed on the [Halo Page](#).

We normally think of an object as having a single material; a color, maybe with a little texture. This works for modeling many of the simpler objects in the real world. However, the real world is not always that simple, and some objects get very complicated. Blender allows you to have multiple materials for different pieces of a mesh. This section describes how to use the multiple material features of Blender.

Vertex groups



Vertex groups menu in the object data context



Sort/copy vertex groups drop down menu

Materials are not assigned to vertex groups but to vertices directly, so it is not necessary to assign vertex groups to a mesh to add multiple materials, but vertex groups is a simple way to manage material assignment.

Managing vertex groups

New vertex groups are easily created by clicking the + sign and existing vertex groups can be easily removed by clicking the - sign next to the list of vertex groups. New groups are added to the list. Vertex groups are easy to manage:

1. Use the up and down arrows to move the selected vertex group up and down the list.
2. The drop down menu offers several more alternatives to sorting and copying vertex groups in the list.

By default Blender names the vertex groups Group, Group.001, and so on. Each vertex group can be renamed in the name field.

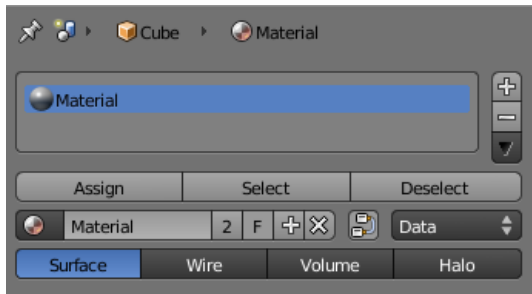
Assigning vertices to a vertex group

Vertices do not get automatically added to a vertex group. Use the Assign and Remove buttons to add or remove selected vertices to the selected vertex group.

As vertices are assigned to vertex groups, Blender assigns a Weight value to these vertices — assigning different weights to different vertices is useful in many contexts but not in regard to materials.

At any time, a vertex group can be selected or deselected using the Select and Deselect buttons.

Assigning materials to vertices



Material menu in edit mode

In the material context, in edit mode, use the Assign button to assign the selected material to selected vertices. Note that this will only work on material slots beyond the first material slot created.

Use the Select and Deselect buttons see what vertices the selected material is assigned to.

Diffuse Shaders

Mode: All Modes

Panel: Shading/Material Context → Diffuse

A diffuse shader determines, simply speaking, the general color of a material when light shines on it. Most shaders that are designed to mimic reality give a smooth falloff from bright to dark from the point of the strongest illumination to the shadowed areas, but Blender also has other shaders for various special effects.

Options

All diffuse shaders have the following options:

Color

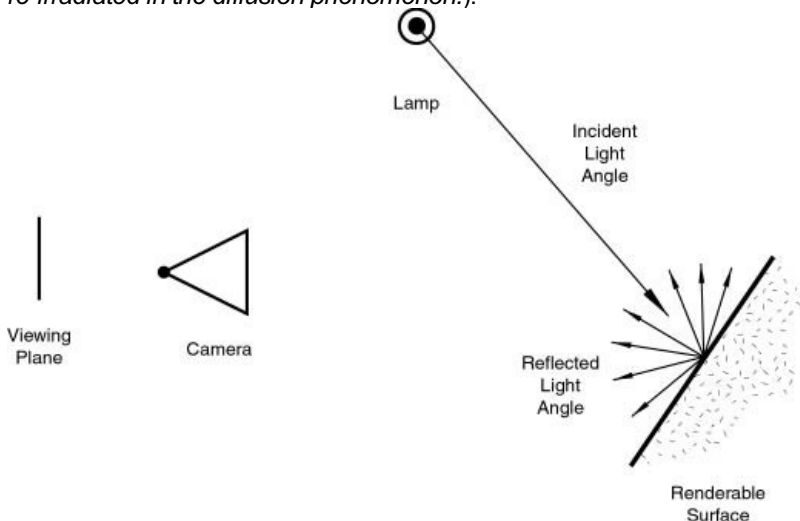
The base *diffuse color* of the material

Intensity

The shader's brightness, or more accurately, the amount of incident light energy that is actually diffusely reflected towards the camera.

Technical Details

Light striking a surface and then re-irradiated via a Diffusion phenomenon will be scattered, i.e., re-irradiated in all directions isotropically. This means that the camera will see the same amount of light from that surface point no matter what the *incident viewing angle* is. It is this quality that makes diffuse light *viewpoint independent*. Of course the amount of light that strikes the surface depends on the incident light angle. If most of the light striking a surface is reflected diffusely, the surface will have a matte appearance (*Light re-irradiated in the diffusion phenomenon.*).



Light re-irradiated in the diffusion phenomenon.

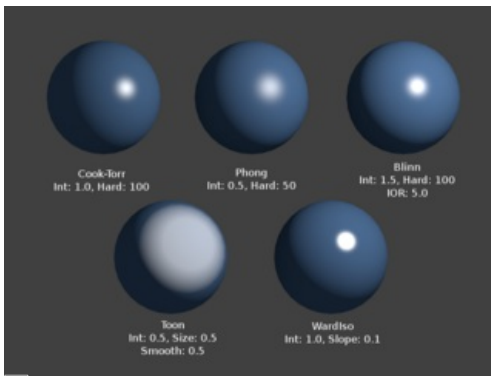
Hints

Some shaders' names may sound odd - they are traditionally named after the people who first introduced the models on which they are based.

Lambert

Mode: All Modes

Panel: Shading/Material Context → Shaders



Lambert Shader

This is Blender's default diffuse shader, and is good general all-around work horse.

[Johann Heinrich Lambert](#) (1728-1777)

was a Swiss mathematician, physicist and astronomer who published works on the reflection of light, most notably the [Beer-Lambert Law](#) which formulates the law of light absorption.

Options

This shader has only the default option, determining how much of available light is reflected. Default is 0.8, to allow some other objects to be brighter.

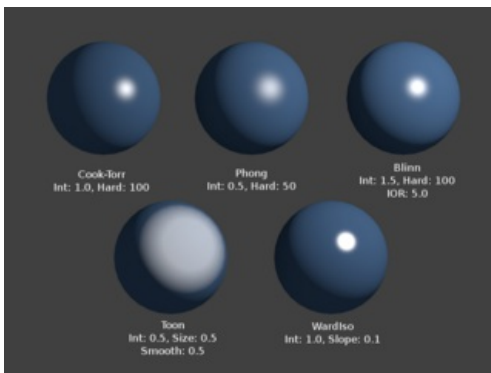


The Lambert diffuse shader settings.

Oren-Nayar

Mode: All Modes

Panel: Shading/Material Context → Shaders



Oren-Nayar Shader

Oren-Nayar takes a somewhat more 'physical' approach to the diffusion phenomena as it takes into account the amount of microscopic roughness of the surface.

[Michael Oren](#) and [Shree K. Nayar](#)

Their [reflectance model](#), developed in the early 1990s, is a generalization of Lambert's law now widely used in computer graphics.

Options

Rough

The roughness of the surface, and hence, the amount of diffuse scattering

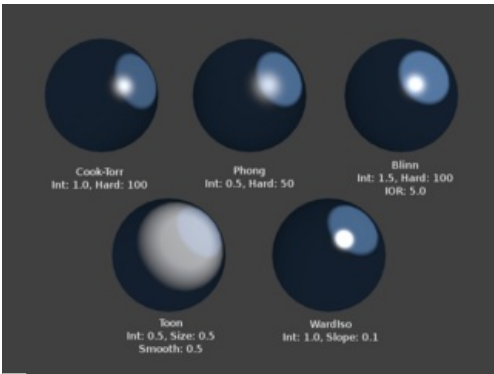


The Oren-Nayar diffuse
shader settings.

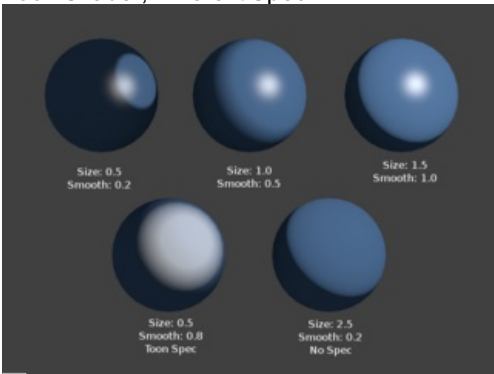
Toon

Mode: All Modes

Panel: Shading/Material Context → Shaders



Toon Shader, Different Spec



Toon Shader Variations

The Toon shader is a very 'un-physical' shader in that it is not meant to fake reality but to produce cartoon cel styled rendering, with clear boundaries between light and shadow and uniformly lit/shadowed regions.

Options

Size

The size of the lit area

Smooth

The softness of the boundary between lit and shadowed areas

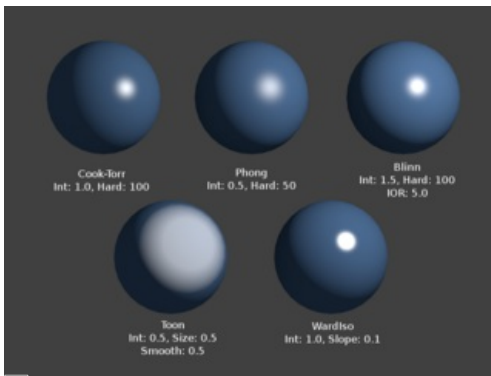


The Toon diffuse shader
settings.

Minnaert

Mode: All Modes

Panel: Shading/Material Context → Shaders



Minnaert Shader

Minnaert works by darkening parts of the standard Lambertian shader, so if *Dark* is 1 you get exactly the Lambertian result. Higher darkness values will darken the center of an object (where it points towards the viewer). Lower darkness values will lighten the edges of the object, making it look somewhat velvet.

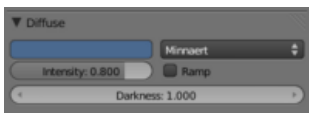
[Marcel Minnaert](#) (1893-1970)

was a Belgian astronomer interested in the effects of the atmosphere on light and images who in 1954 published a book entitled *The Nature of Light and Color in the Open Air*.

Options

Dark

The darkness of the 'lit' areas (higher) or the darkness of the edges pointing away from the light source (lower).

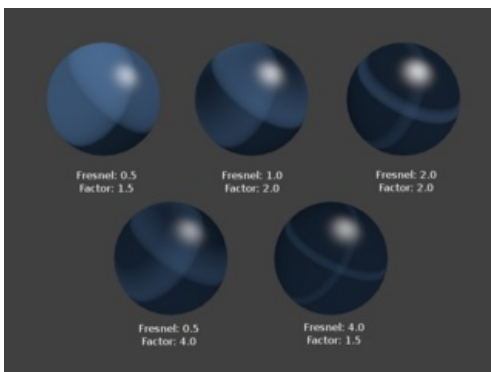


The Minnaert diffuse shader settings.

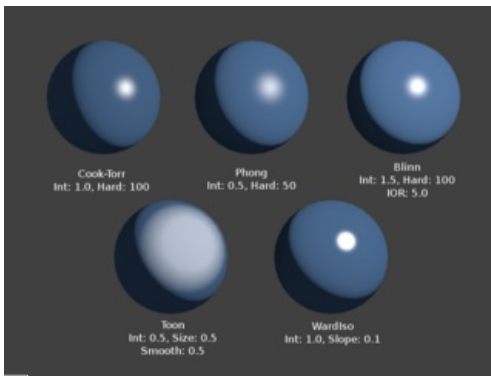
Fresnel

Mode: All Modes

Panel: Shading/Material Context → Shaders



Various settings for the Fresnel shader, Cook-Torr Specular shader kept at Intensity 0.5, Hardness: 50



Fresnel Shader, Different Spec

With a Fresnel Shader the amount of diffuse reflected light depends on the incidence angle, i.e. from the direction of the light source. Areas pointing directly towards the light source appear darker, areas perpendicular to the incoming light become brighter.

[Augustin-Jean Fresnel](#) (1788-1827)

was a French physicist who contributed significantly to the establishment of the theory of wave optics.

Options

Fresnel

Power of the Fresnel effect, 5.0 is max.

Factor

Blending factor of the Fresnel factor to blend in, 5.0 is max.



The Fresnel diffuse shader settings.

Specular Shaders

Mode: All Modes

Panel: Shading/Material Context → Specular

Description

Specular shaders create the bright highlights that one would see on a glossy surface, mimicking the reflection of light sources. Unlike [diffuse shading](#), specular reflection is *viewpoint dependent*. According to Snell's Law, light striking a specular surface will be reflected at an angle which mirrors the incident light angle (with regard to the surface's normal), which makes the viewing angle very important.

Note

It is important to stress that the *specular reflection* phenomenon discussed here is not the reflection we would see in a mirror, but rather the light highlights we would see on a glossy surface. To obtain true mirror-like reflections you would need to use the internal raytracer. Please refer to section [RENDERING](#) of this manual.

Options

Each specular shader shares two common options:

Specular color

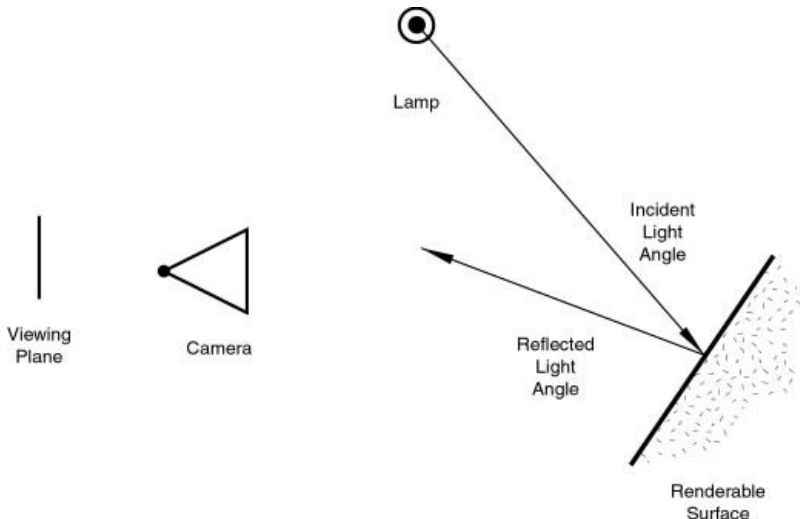
The color of the specular highlight

Intensity

The intensity, or brightness of the specular highlight. This has a range of [0-1].

As a result, a material has at least two different colors, a diffuse, and a specular one. The specular color is normally set to pure white (the same "pure white" as the reflected light source), but it can be set to different values for various effects (e.g. metals tend to have colored highlights).

Technical Details



Specular Reflection.

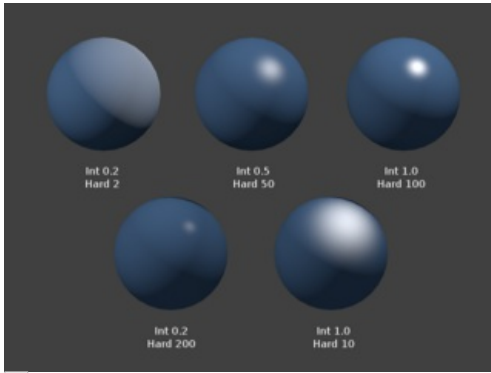
In reality, Diffusion and Specular reflection are generated by exactly the same process of light scattering. Diffusion is dominant from a surface which has so much small-scale roughness in the surface, with respect to wavelength, that light is reflected in many different directions from each tiny bit of the surface, with tiny changes in surface angle.

Specular reflection, on the other hand, dominates on a surface which is smooth, with respect to wavelength. This implies that the scattered rays from each point of the surface are directed almost in the same direction, rather than being diffusely scattered. It's just a matter of the scale of the detail. If the surface roughness is much smaller than the wavelength of the incident light it appears flat and acts as a mirror.

If it is difficult for you to understand the relation between roughness' scale and light's wavelength, try to imagine a ball (say, of centimeter scale): if you throw it against a wall of raw stones (with a scale of roughness of a decimeter), it will bounce in a different direction each time, and you will likely quickly lose it! On the other hand, if you throw it against a concrete wall (with a roughness of, say, a millimeter scale), you can quite easily anticipate its bounce, which follow (more or less!) the same law as the light reflection...

Mode: All Modes

Panel: Shading/Material Context → Shaders



CookTorr Shader (Lambert 0.8)

Description

CookTorr (Cook-Torrance) is a basic specular shader that is most useful for creating shiny plastic surfaces. It is a slightly optimized version of Phong.

Robert L. Cook (LucasFilm) and Kenneth E. Torrance (Cornell University)

In their 1982 paper [A Reflectance Model for Computer Graphics](#) (PDF), they described "a new reflectance model for rendering computer synthesized images" and applied it to the simulation of metal and plastic.

Options

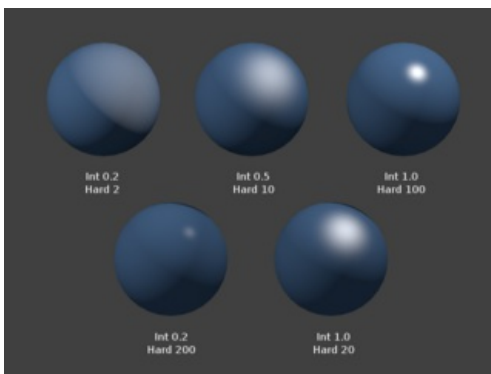
Hardness

Size of the specular highlight

Phong

Mode: All Modes

Panel: Shading/Material Context → Shaders



Phong Shader (Lambert 0.8)

Description

Phong is a basic shader that's very similar to CookTorr, but is better for skin and organic surfaces

[Bui Tuong Phong](#) (1942-1975)

was a Vietnamese-born computer graphics pioneer that developed the first algorithm for simulating specular phenomenon. [His model](#) included components for not only specular lighting, but also diffuse and ambient lighting.

Options

Hardness

Size of the specular highlight

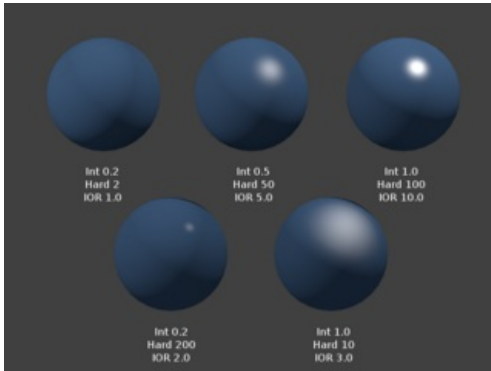
Planet Atmosphere

Because of its fuzziness, this shader is good for atmosphere around a planet. Add a sphere around the planet, slightly larger than the planet. For its material, use a phong specular shader. Set it very low alpha (.05), zero diffuse, low hardness (5) but high specularity (1).

Blinn

Mode: All Modes

Panel: Shading/Material Context → Shaders



Blinn Shader (Oren-Nayar Int 0.8, Rough 0.5)

Description

Blinn is a more 'physical' specular shader, often used with the Oren-Nayar diffuse shader. It can be more controllable because it adds a fourth option, an *index of refraction* (IOR), to the aforementioned three.

[James F. Blinn](#)

worked at NASA's Jet Propulsion Laboratory and became widely known for his work on Carl Sagan's TV documentary *Cosmos*. The model he described in his 1977 paper [Models of Light Reflection for Computer Synthesized Pictures](#) (PDF) included changes in specular intensity with light direction and more accurately positioned highlights on a surface.

Options

Hardness

Size of the specular highlight. The Blinn shader is capable of much tighter specular highlights than Phong or CookTorr.

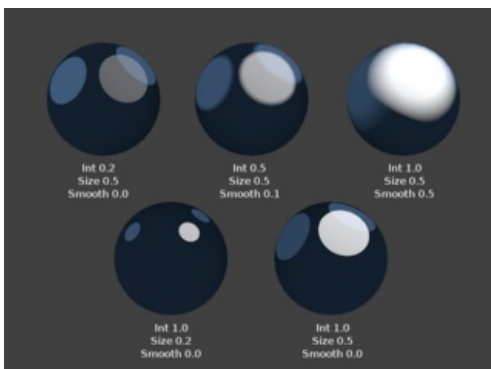
IOR

'Index of Refraction'. This parameter is not actually used to compute refraction of light rays through the material (a ray-tracer is needed for that), but to correctly compute specular reflection intensity and extension via Snell's Law.

Toon

Mode: All Modes

Panel: Shading/Material Context → Shaders



Toon Specular Shader (Toon Diffuse, Int 0.8, Size & Smooth match)

Description

The Toon specular shader matches the Toon diffuse shader. It is designed to produce the sharp, uniform highlights of cartoon cels.

Options

Size

Size of the specular highlight

Smooth

Softness of the highlight's edge

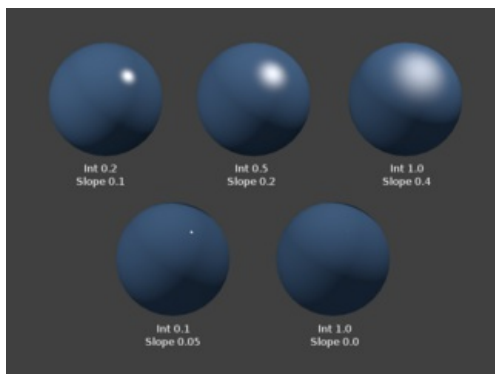
Hints

Toon shader can be also be accomplished in a more controllable way using ColorRamps.

WardIso

Mode: All Modes

Panel: Shading/Material Context → Shaders



WardIso Shader

Description

WardIso is a flexible specular shader that can be useful for metal or plastic.

Gregory J. Ward

developed a relatively simple model that obeyed the most basic laws of physics. In his 1992 paper *Measuring and modeling anisotropic reflection* Ward introduced a Bidirectional Reflectance Distribution Function (BRDF) since then widely used in computer graphics because the few parameters it uses are simple to control. His model could represent both isotropic surfaces (independent of light direction) and anisotropic surfaces (direction dependent). In Blender, the Ward specular shader is still called **Ward Isotropic** but is actually anisotropic. ([PDF](#))

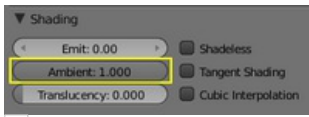
Options

Slope

Standard deviation for of surface slope. Previously known as the [root-mean-square](#) or rms value, this parameter in effect controls the size of the specular highlight, though using a different method to that of the other specular shaders. It is capable of extremely sharp highlights.

The following setting depends on how you set the [Ambient Light](#).

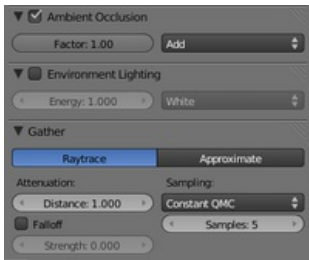
Material Ambient Effect



The Ambient slider.

Each object's material setting (diffuse shader) has an Ambient slider that lets you choose how much ambient light that object receives.

In Blender 2.5 this is set to 1.0 by default. You should set this slider depending on the amount of ambient light you think the object will receive. Something deep in the cave will not get any ambient light, whereas something close to the entrance will get more. Note that you can animate this effect, to change it as the object comes out of the shadows and into the light.



World settings for Ambient Occlusion and Environment Lighting.

Settings for Ambient Occlusion and Environment Lighting can be found in the World menu, with parameters affecting both these lighting components found in the World Gather menu.

Ramps

Mode: All Modes

Panel: Context Shading → sub-context Material → Ramps

In many real life situations — like skin or metals — the color of diffuse and specular reflections can differ slightly, based on the amount of energy a surface receives or on the light angle of incidence. The Ramp Shader options in Blender allow you to set a range of colors for a Material, and define how the range will vary over a surface, and how it blends with the 'actual color' (typically from a material or as output of a texture).

Description

Ramps allow you to precisely control the color gradient across a material, rather than just a simple blend from a brightened color to a darkened color, from the most strongly lit area to the darkest lit area. As well as several options for controlling the gradient from lit to shadowed, ramps also provide 'normal' input, to define a gradient from surfaces facing the camera to surfaces facing away from the camera. This is often used for materials like some types of metallic car paint, that change color based on viewing angle.

Since texture calculations in Blender happen before shading, the Ramp Shader can completely replace texture or material color. But by use of the mixing options and Alpha values it is possible to create an additional layer of shading in Blender materials.

Options




Ramps Panel

In Blender 2.5, the separate Ramp panels for the Diffuse shader and the Specular shader respectively can be toggled on and off using the ☒ Ramp button.

By default the Ramp panel opens with two colors; the first (stop 0) is black and transparent (Alpha=0) and the second (stop 1) is white and opaque (Alpha=1).

The position of the color stop markers can be altered by either (1) dragging the stop marker in the colorband or (2) by changing the Pos value in the box.

Color and alpha values for each marker can be set by clicking the  box.



Input popup menu

Input

The input menu contain the following options for defining the gradient:

Shader

The value as delivered by the material's shader (Lambert, CookTorr) defines the color. Here the amount of light doesn't matter for color, only the direction of the light.

Energy

As Shader, now also lamp energy, color, and distance, is taken into account. This makes the material change color when more light shines on it.

Normal

The surface normal, relative to camera, is used for the Ramp Shader. This is possible with a texture as well, but added for convenience.

Result

While all three previous options work per lamp, this option only works in the end of all shading calculations. This allows full control over the entire shading, ncluding 'Toon' style results. Using alpha values here is most useful for tweaking a finishing touch to a material.



Blend popup menu

Blend

A list of the various blending modes available for blending the ramp shader with the color from Input.

Factor

This slider denotes the overall factor of the ramp shader with the color from Input.

Colorbands


Mode: All Modes

Panel: Context Shading → sub-context Material → Ramps

A colorband can contain a gradient through a sequence of many colors (with alpha), each color acting across a certain position in the spectrum. Colorbands are used in both materials and textures, as well in other places where a range of colors can be computed and displayed.

Options

Add

Add a new mark to the center of the colorband with the default color (neutral grey). New marks can also be added by Ctrl LMB  clicking in the colorband itself, which will add the mark at the position of the click with the same color as already existing underneath the mouse pointer.



Delete

Remove the currently selected mark from the colorband.


F

Flip the colorband.

0


The number of the active mark. The values for this mark are those being displayed, and in the colorband, the active mark is displayed as a dashed line. Another marker can be selected (1) using the arrows in the  slider, (2) by clicking on the number being displayed and enter a number of a color mark, or (3) by LMB  clicking a marker in the colorband.

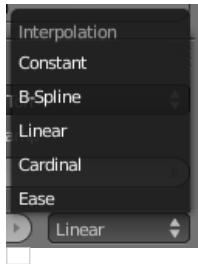
Pos

The position of the active color mark in the colorband (range 0.0–1.0). The position of the color marks can also be changed by LMB  dragging them in the colorband.

Reordering colors

If the position of the color marks are reordered, they will be automatically renumbered so that they always start with 0 from the left and increment to the right.

The Colorswatch right of the Position slider displays the color of the active mark. LMB  click it to display a color picker in which values for color (RGB) and transparency (Alpha) can be set.



Interpolation
popup menu

Linear

Various modes of interpolation between marker's values can be chosen in the Interpolation menu:

Ease

Ease by quadratic equation.

Cardinal

Cardinal.

Linear

Linear (default). A smooth, consistent transition between colors.

B-Spline

B-Spline.

Constant

Constant.

Raytraced Mirror Reflections

Mode: All Modes

Panel: Shading/Material Context → Mirror Transp

Description

Raytracing can be used to make a material reflect its surroundings, like a mirror. The principle of raytraced reflections is very simple: a ray is fired from the camera and travels through the scene until it encounters an object. If the first object hit by the ray is not reflective, then the ray takes the color of the object. If the object is reflective, then the ray bounces from its current location and travels up to another object, and so on, until a non-reflective object is finally met and gives the whole chain of rays its color.

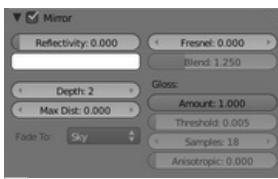
Eventually, the first reflective object inherits the colors of its environment, proportionally to its Reflectivity value. Obviously, if there are only reflective objects in the scene, then the render could last forever. This is why a mechanism for limiting the travel of a single ray has been set through the Depth value: this parameter sets the maximum number of bounces allowed for a single ray.

Note

You need to enable raytracing in your scene settings if you want to use raytraced reflections. This is done in the Scene/Render context → Render Panel. Raytracing is enabled by default in Blender 2.37 and higher.

The *Color Swatch* in the mirror panel is the color of the light reflected back. Usually, for normal mirrors, use white. However, some mirrors color the reflection (e.g. metals), so you can change the color by clicking on the swatch. The amount of mirrored reflection is determined by the Reflectivity value. If set to something greater than 0, mirrored reflectivity will be activated and the reflection will be tinted the color set in the swatch.

Options



The Mirror Panel

Enable raytraced reflections

Enable or disable raytraced reflections

Reflectivity

Sets the amount of reflectiveness of the object. Use a value of 1.0 if you need a perfect mirror; or set it to 0.0 if you don't want any reflection.



Picking a mirror color

Color swatch

Color of mirrored reflection

By default, an almost perfectly reflective material like chrome, or a mirror object, will reflect the exact colors of its surrounding. But some other equally reflective materials tint the reflections with their own color. This is the case for well polished copper and gold, for example. In order to replicate this within Blender, you have to set the Mirror Color accordingly. To set a mirror color, simply click the color swatch in the mirror panel and select a color.

Fresnel

Sets the power of the Fresnel effect. The Fresnel effect controls how reflective the material is, depending on the angle between the surface normal and the viewing direction. Typically, the larger the angle, the more reflective a material becomes (this generally occurs on the outline of objects).

Blend

A controlling factor to adjust how the blending happens between the reflective and non-reflective areas.

Depth

Maximum allowed number of light inter-reflections. If your scene contains many reflective objects and/or if the camera zooms in on such a reflective object, you will need to increase this value if you want to see surrounding reflections in the reflection of the reflected object (!). In this case, a Depth of 4 or 5 is typically a good value.

Max Dist

Maximum distance of reflected rays away from camera (Z-Depth) in Blender units. Reflections further than this range fade out to reduce compute time.

Fade to

The color that rays with no intersection within the Max Distance take. Material color can be best for indoor scenes, Sky color (World settings) for outdoor scenes.



Suzanne in the Fun House
([.blend](#))

Gloss

In paint, a high-gloss finish is very smooth and shiny. A flat, or low gloss disperses the light and gives a very blurry reflection. Also, uneven or waxed-but-grainy surfaces (such as car paint) are not perfect and therefore slightly need a Gloss < 1.0. In the example to the right, the left mirror has a Gloss of 0.98, the middle is Gloss = 1.0, and the right one has Gloss of 0.90. Use this setting to make a realistic reflection, all the way up to a completely foggy mirror. You can also use this value to mimic depth of field in mirrors.

Amount

The shininess of the reflection. Values < 1.0 give diffuse, blurry reflections and activate the settings below.

Threshold

Threshold for adaptive sampling. If a sampling contributes less than this amount (as percentage), sampling is stopped. Raising the threshold will make the adaptive sampler skip more often, however the reflections could become noisier.

Samples

Number of cone samples averaged for blurry reflection. More samples will give a smoother result, but will also increase render time.



Anisotropic tangent
reflecting spheres with
anisotropic set to 0.0,
0.75, 1.0. ([.blend](#))

Anisotropic

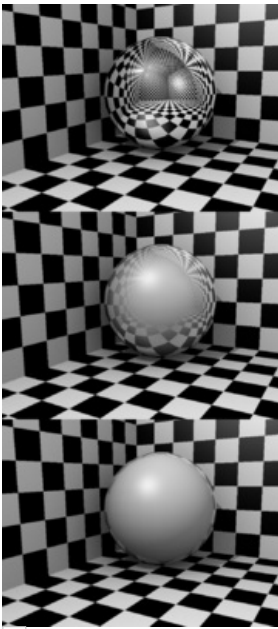
The shape of the reflection, from 0.0 (circular) to 1.0 (fully stretched along the tangent). If the Tangent Shading is on, Blender automatically renders blurry reflections as anisotropic reflections.

When Tangent is switched on, the *Anisotropic* slider controls the strength of this anisotropic reflection, with a range of 1.0 (default) being fully anisotropic and 0.0 being fully circular, as is when tangent shading on the material is switched off.

Anisotropic raytraced reflection uses the same tangent vectors as for tangent shading, so you can modify the angle and layout the same way, with the auto-generated tangents, or based on the mesh's UV co-ordinates.

Examples

Fresnel



Demonstration of Fresnel effect with values equal to (from top to bottom) 0.0, 2.5 and 5.0

Let's undertake a small experiment in order to understand what Fresnel is really about. After a rainy day, go out and stand over a puddle of water. You can see the ground through the puddle. If you kneel just in front of the puddle, your face close to the ground, and look again at a distant point on the puddle of water, the liquid surface part which is closer to you lets you see the ground, but if you move your gaze towards the other end of the puddle, then the ground is gradually masked until all you see is the reflection of the sky. This is the Fresnel effect: having a surface sharing reflective and non-reflective properties according to the viewing angle and the surface normal.

In *Demonstration of Fresnel effect with values equal to (from top to bottom) 0.0, 2.5 and 5.0*, this behavior is demonstrated for a perfectly reflective Material (Mirror Reflectivity 1.0).

Fresnel 0.0 stands for a perfect mirror Material, while Fresnel 5.0 could stand for a glossy Material. It's barely noticeable but in the lower picture, the Material is perfectly reflective around the edges.

The smoothness of the Fresnel limit can be further controlled using the Blend slider.

Transparency

Mode: All Modes

Panel: Shading/Material Context → Transparency

Materials in Blender can be set to be transparent, so that light can pass through. There are three types of transparency a material can be set to:



Z-Transparency Render



Raytraced render, with
IOR=1.2

Mask

Simply masks the Background. Useful for composition further down the pipeline—See [Mask Transparency](#).

Z Transparency

This uses the alpha buffer for transparent faces. Only basic settings are available with this option, and cannot calculate refractions.

Raytrace

Uses raytracing to calculate refractions. Raytracing allows for complex refractions, falloff, and blurring.

(To see the .blend that generated the images to the right, click here: [File:Manual-Materials-Properties-RaytracedTransparency Comparison.blend](#)).

Raytraced Transparency

Raytracing is used for simulating the refraction of light rays through a transparent material, like a lens. A ray is sent from the camera and travels through the scene until it encounters an object. If the first object hit by the ray is non-transparent, then the ray takes the color of the object.

If the object is transparent, then the ray continues its path through it to the next object, and so on, until a non-transparent object is finally encountered which gives the whole chain of rays its color. Eventually, the first transparent object inherits the colors of its background, proportionally to its Alpha value (and the Alpha value of each transparent Material hit in-between).

But while the ray travels through the transparent object, it can be deflected from its course according to the Index of Refraction (IOR) of the material. When you actually look through a plain sphere of glass, you will notice that the background is upside-down and distorted: this is all because of the Index of Refraction of glass.

Enable Raytracing

To get raytraced transparency, you need to:

1. enable raytracing in your Render settings. This is done in the Render context → Shading Panel. Raytracing is enabled by default.
2. set your Alpha value to something else than 1.0.
3. in order for the background material to receive light passing through your transparent object, Receive Transparent must be turned on for that material in the Material → Shadow panel.

Options

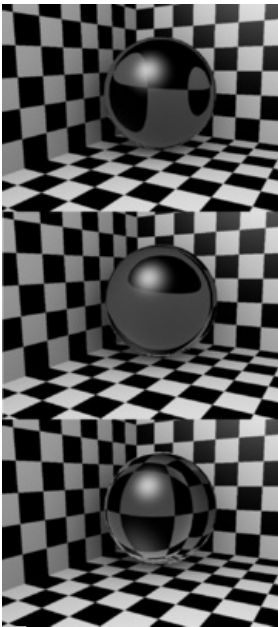


The Transparency Panel.

- Alpha
 - Sets the amount of transparency of the material.
- Specular
 - Controls the alpha/falloff for the specular color.
- Fresnel
 - Sets the power of the Fresnel effect. the Fresnel effect controls how transparent the material is, depending on the angle between the surface normal and the viewing direction. Typically, the larger the angle, the more opaque a material becomes (this generally occurs on the outline of the object).
- Blend
 - Controls the blending between transparent and non-transparent areas. Only used if Fresnel is greater than 0.
- IOR
 - Index of Refraction. Sets how much a ray traveling through the material will be refracted, hence producing a distorted image of its background. See [IOR values for Common Materials](#) below.
- Filter
 - Amount of filtering for transparent ray trace. The higher this value, the more the base color of the material will show. The material will still be transparent but it will start to take on the color of the material. Disabled (0.0) by default.
- Falloff
 - How fast light is absorbed as it passes through the material. Gives 'depth' and 'thickness' to glass.
- Limit
 - Materials thicker than this are not transparent. This is used to control the threshold after which the filter color starts to come into play.
- Depth
 - Sets the maximum number of transparent surfaces a single ray can travel through. There is no typical value. Transparent objects outside the Depth range will be rendered pitch black if viewed through the transparent object that the Depth is set for. In other words, if you notice black areas on the surface of a transparent object, the solution is probably to increase its Depth value (this is a common issue with raytracing transparent objects). You may also need to turn on transparent shadows on the background object.
- Gloss
 - Settings for the glossiness of the material.
 - Amount
 - The clarity of the refraction. Set this to something lower than zero to get a blurry refraction.
 - Threshold
 - Threshold for adaptive sampling. If a sample contributes less than this amount (as percentage), sampling is stopped.
 - Samples
 - Number of cone samples averaged for blurry refraction.

Examples

Index of Refraction



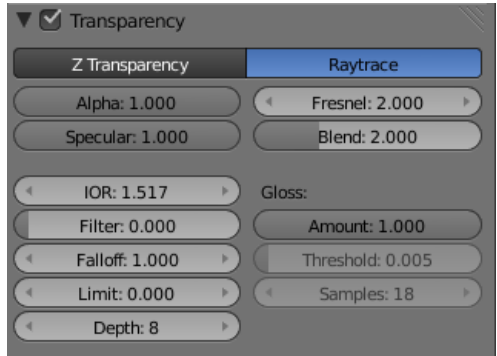
Influence of the IOR of an Object on the distortion of the background: spheres of Water, Glass and Diamond (top to bottom).

(Influence of the IOR of an Object on the distortion of the background: spheres of Water, Glass and Diamond (top to bottom).). There are different values for typical materials: Air is **1.000** (no refraction), Alcohol is **1.329**, Glass is **1.517**, Plastic is **1.460**, Water is **1.333** and Diamond is **2.417**.

Fresnel



16 pieces of glass rotated in various directions demonstrate the angle dependent Fresnel effect with raytraced (left) and alpha buffered transparency (right). Note that the major difference is the lack of IOR effect in the latter case. (Download [blend](#).)

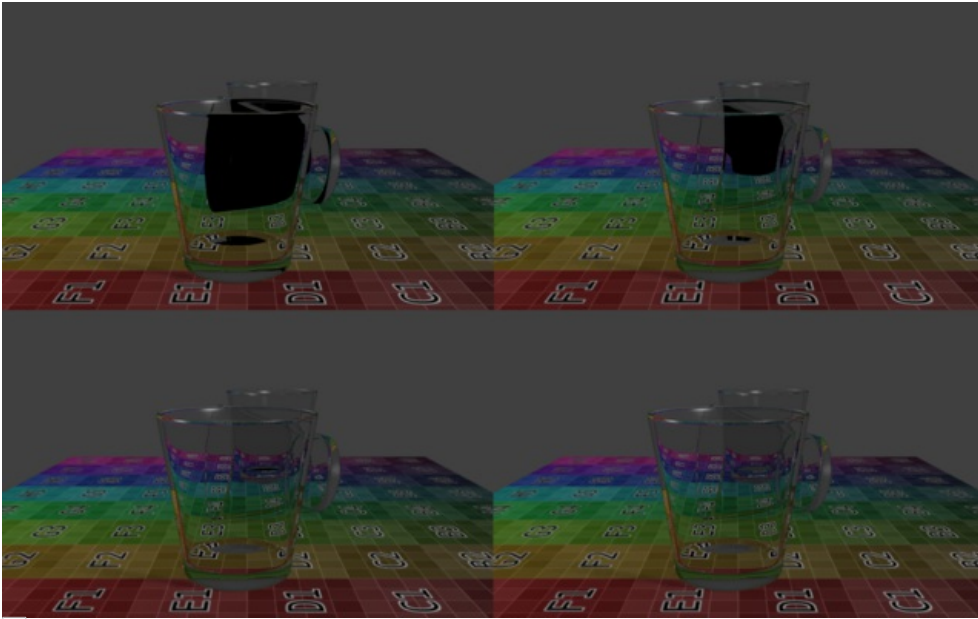


Settings for Fresnel using raytrace (left) and Z transparency (right).

Note the specular highlight in the F4 glass tile (which is facing midway between the light and the camera); the Fresnel effect can be seen in row C and column 6 where the faces are turned away from the camera.

The amount of Fresnel effect can be controlled by either increasing the Blend value or decreasing the Alpha value.

Depth



A simple scene with three glasses on a surface and three lamps. Depth was set to 4, 8, 12, and 14, resulting in render times of 24 sec, 34 sec, 6 min, and 11 min respectively. (Download [.blend](#).)

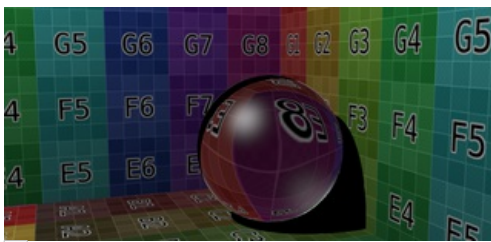
Increasing Depth also considerably increases render time. Each time a light ray passes through a surface, the raytracing algorithm is called recursively. In the example above, each side of each glass has an exterior and an interior surface. Light rays thus have to pass through four surfaces for each glass.

But not only that, at every point on a surface some of the light can be reflected, or mirrored off the surface in various directions. This results in multiple rays needing to be calculated for each point (often referred to as a **tree of rays**[\[1\]](#)). In each of the rendered images above there are $640 \times 400 = 256\,000$ pixels. By increasing Depth, at least one tree of rays is added to each pixel.

Be kind to your computer. Carefully placing objects in a scene to avoid overlapping transparent objects is often an interesting alternative.

Hints

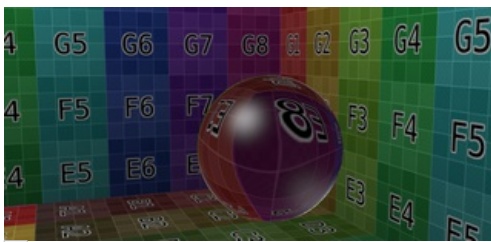
Transparent shadows



No transparent shadows



No transparent shadows, environment lighting enabled



Transparent shadows enabled, alpha set to 0.0



As previous, alpha set to 0.25



Transparent shadows with ambient occlusion set to multiply, distance 1 (radius of sphere)

As previous, distance increased to 2 (diameter of sphere)

By default, the shadows of transparent objects are rendered solid black, as if the object was not transparent at all. But in reality, the more transparent an object is, the lighter its shadow will be.

In Blender, transparent shadows are set on the materials that receive the shadows from the transparent object. This is enabled and disabled with the Receive Transparent button, in the Material context → Shadow panel. The shadow's brightness is dependent on the Alpha value of the shadow casting material.

Alternatives to transparent raytraced shadows can be found in the World context, namely the Ambient Occlusion, Environment Lighting, and Gather panels. Alternatively, a texture can be used to control the Intensity value of the shadow-receiving material.

IOR values for Common Materials

The following list provides some index of refraction values to use when raytraced transparency is used for various liquids, solids (gems), and gases:

A		E		J		S	
Acetone	1.36	Ebonite	1.66	Jade, Jadeite	1.64 - 1.667	Sanidine	1.522
Actinolite	1.618	Ekanite	1.600			Sapphire	1.757 - 1.779
Agalmatolite	1.550	Elaeolite	1.532	Jade, Nephrite	1.600 - 1.641		1.760 - 1.773
Agate	1.544	Emerald	1.560 - 1.605	Jadeite	1.665	Sapphire, Star	1.540
Agate	1.540			Jasper	1.540	Scapolite	1.555
Air	1.000	Emerald Catseye	1.560 - 1.605	Jet	1.660	Scapolite, Yellow	1.920
Alcohol	1.329	Emerald, Synth flux	1.561	K		Scheelite	2.92
Alcohol, Ethyl (grain)	1.36	Emerald, Synth hydro	1.568	Kornerupine	1.665	Selenium, Amorphous	1.560
Alexandrite	1.745	Enstatite	1.663	Kunzite	1.660 - 1.676	Serpentine	1.362
Alexandrite	1.750	Epidote	1.733			Shampoo	1.530
Almandine	1.83	Ethanol	1.36	Kyanite	1.715	Shell	4.24
Aluminum	1.44	Ethyl Alcohol	1.36	L		Silicon	1.658
Amber	1.545	Euclase	1.652	Labradorite	1.560 - 1.572	Sillimanite	0.18
Amblygonite	1.611	F		Lapis Gem	1.500	Silver	1.699
Amethyst	1.540	Fabulite	2.409	Lapis Lazuli	1.50 - 1.55	Sinhalite	1.608
Ammolite	1.600	Feldspar, Adventurine	1.532	Lazulite	1.615	Smaragdite	1.621
Anatase	2.490	Feldspar, Albite	1.525	Lead	2.01	Smithsonite	1.483
Andalusite	1.640	Feldspar, Amazonite	1.525	Leucite	1.509	Sodalite	1.544
Anhydrite	1.571	Feldspar, Labradorite	1.565	M		Sodium Chloride	1.79 - 1.81
Apatite	1.632	Feldspar, Microcline	1.525	Magnesite	1.515	Spessartite	2.368
Apophyllite	1.536	Feldspar, Oligoclase	1.539	Malachite	1.655	Sphalerite	1.885
Aquamarine	1.575	Flourite	1.434	Meerschaum	1.530	Sphene	1.712 - 1.717
Aragonite	1.530	Formica	1.47	Mercury (liq)	1.62	Spinel	1.712 - 1.747
Argon	1.000281	G		Methanol	1.329		1.708 - 1.735
Asphalt	1.635			Milk	1.35	Spinel, Blue	1.650
Axinite	1.674 - 1.704	Garnet, Andradite	1.88 - 1.94	Moldavite	1.500		1.76 - 1.773
Axinite	1.675	Garnet, Demantoid	1.880 - 1.9		1.518 - 1.526	Spinel, Red	1.739
Azurite	1.730	Garnet, Demantoid	1.880	Moonstone		Spodumene	1.539
B		Garnet, Grossular	1.738	Moonstone, Adularia	1.525	Star Ruby	2.50
Barite	1.636	Garnet, Hessonite	1.745				1.520
Barytocalcite	1.684	Garnet, Mandarin	1.790 - 1.8	Moonstone, Albite	1.535	Staurolite	
Beer	1.345	Garnet, Pyrope	1.73 - 1.76		1.585 - 1.594	Steatite	
Benitoite	1.757	Garnet, Rhodolite	1.740 - 1.770	Morganite		Steel	
Benzene	1.501	N				Stichtite	

Beryl	1.57 - 1.60	Garnet, Rhodolite	1.760	Natrolite	1.480	Strontium Titanate	2.410
Beryl, Red	1.570 - 1.598	Garnet, Spessartite	1.810	Nephrite	1.600	Styrofoam	1.595
Beryllonite	1.553	Garnet, Tsavorite	1.739 - 1.744	Nitrogen (gas)	1.000297	Sugar Solution 30%	1.38
Brazilianite	1.603	Garnet, Uvarovite	1.74 - 1.87	Nitrogen (liq)	1.2053	Sugar Solution 80%	1.49
Bromine (liq)	1.661	Gaylussite	1.517	Nylon	1.53	Sulphur	1.960
Bronze	1.18	Glass	1.51714	Obsidian	1.489	Synthetic Spinel	1.730
Brownite	1.567	Glass, Albite	1.4890	Oil of Wintergreen	1.536	Taaffeite	1.720
Calcite	1.486	Glass, Crown	1.520	Oil, Clove	1.535	Tantalite	2.240
Calspar	1.486	Glass, Crown, Zinc	1.517	Oil, Lemon	1.481	Tanzanite	1.690-1.7
Cancrinite	1.491	Glass, Flint, Dense	1.66	Oil, Neroli	1.482	Teflon	1.35
Carbon Dioxide (gas)	1.000449	Glass, Flint, Heaviest	1.89	Oil, Orange	1.473	Thomsonite	1.530
Carbon Disulfide	1.628	Glass, Flint, Heavy	1.65548	Oil, Safflower	1.466	Tiger eye	1.544
Carbon Tetrachloride	1.460	Glass, Flint, Light	1.58038	Oil, vegetable (50° C)	1.47	Topaz	1.607 - 1.627
Carbonated Beverages	1.34 - 1.356	Glass, Flint, Medium	1.62725	Olivine	1.670	Topaz, Blue	1.610
Cassiterite	1.997	Glycerine	1.473	Onyx	1.486	Topaz, Imperial	1.605 - 1.640
Celestite	1.622	Gold	0.47	Opal, Black	1.440 - 1.460	Topaz, Pink	1.620
Cerussite	1.804	Hambergite	1.559	Opal, Fire	1.430 - 1.460	Topaz, White	1.630
Ceylonite	1.770	Hauyne	1.490 - 1.505	Opal, White	1.440 - 1.460	Topaz, Yellow	1.620
Chalcedony	1.544 - 1.553	Hauynite	1.502	Oregon Sunstone	1.560 - 1.572	Tourmaline	1.603 - 1.655
Chalk	1.510	Helium	1.000036	Oxygen (gas)	1.000276	Tourmaline	1.624
Chalybite	1.630	Hematite	2.940	Oxygen (liq)	1.221	Tourmaline, Blue	1.61 - 1.64
Chlorine (gas)	1.000768	Hemimorphite	1.614	Padparadja	1.760 - 1.773	Tourmaline, Catseye	1.61 - 1.64
Chlorine (liq)	1.385	Hiddenite	1.655	Painite	1.787	Tourmaline, Green	1.61 - 1.64
Chrome Green	2.4	Honey, 13% water content	1.504	Pearl	1.530	Tourmaline, Paraiba	1.61 - 1.65
Chrome Red	2.42	Honey, 17% water content	1.494	Periclase	1.740	Tourmaline, Red	1.61 - 1.64
Chrome Tourmaline	1.61 - 1.64	Honey, 21% water content	1.484	Peridot	1.635 - 1.690	Tremolite	1.600
Chrome Yellow	2.31	Howlite	1.586	Peristerite	1.525	Tugtupite	1.496
Chromium	2.97	Hydrogen (gas)	1.000140	Petalite	1.502	Turpentine	1.472
Chrysoberyl	1.745	Hydrogen (liq)	1.0974	Phenakite	1.650	Turquoise	1.610
Chrysoberyl, Cat's eye	1.746 - 1.755	Hypersthene	1.670	Phosgenite	2.117	Ulexite	1.490
Chrysocolla	1.500	Ice	1.309	Plastic	1.460	Uvarovite	1.870
Chrysoprase	1.534	Idocrase	1.713	Plexiglas	1.50	Wardite	1.590
Citrine	1.532 - 1.554	Iodine Crystal	3.34	Polystyrene	1.55	Variscite	1.550
Citrine	1.550	Iolite	1.522 - 1.578	Prase	1.540	Water (0° C)	1.33346
Clinohumite	1.625 - 1.675	Iron	1.51	Prasiolite	1.540	Water (100° C)	1.31766
Clinozoisite	1.724	Ivory	1.540	Prehnite	1.610	Water (20° C)	1.33283
Cobalt Blue	1.74			Proustite	2.790	Water (gas)	1.000261
Cobalt Green	1.97			Purpurite	1.840	Water (35° C, room temp)	1.33157
Cobalt Violet	1.71			Pyrite	1.810	Whisky	1.356
Colemanite	1.586			Pyrope	1.740	Willemite	1.690
Copper	1.10			Quartz	1.544 - 1.553	Witherite	1.532
Copper Oxide	2.705			Quartz, Fused	1.45843	Vivianite	1.580
Coral	1.486			Rhodizite	1.690	Vodka	1.363
Coral	1.486 - 1.658			Rhodochrisite	1.600	Wulfenite	2.300
Cordierite	1.540			Rhodonite	1.735	Zincite	2.010
Corundum	1.766			Rock Salt	1.544	Zircon	1.777 - 1.987
Cranberry Juice (25%)	1.351			Rubber, Natural	1.5191	Zircon, High	1.960
Crocoite	2.310					Zircon, Low	1.800
						Zirconia, Cubic	2.173 - 2.21

Crystal	2.000
Cuprite	2.850
D	
Danburite	1.627 - 1.641
Danburite	1.633
Diamond	2.417
Diopside	1.680
Dolomite	1.503
Dumortierite	1.686

Rubber, Natural	1.515 -
Ruby	1.757 - 1.779
Rum, White	1.361
Rutile	2.62

Subsurface Scattering

Mode: All Modes

Panel: Shading/Material Context → Subsurface Scattering

Many organic and some inorganic skins are not totally opaque right at the surface, so light does not just bounce off the top surface. Instead, some light also penetrates the skin surface, and scatters around inside, taking on the color of the insides and emerging back out to blend with the surface reflection. Human/animal skin, the skin of grapes, tomatoes, fruits, wax, gels (like honey, or Jello) and so on all have subsurface scattering (SSS), and photo-realism really cannot be achieved without it.

SSS can be found in the Material buttons, and is limited to diffuse shading only, it does not affect specular shading.

How it works

Actually calculating the light path beneath the surface of an object would be practically impossible. But it has been shown that it is not necessary to do this, and that one can use a different approach.

Blender calculates SSS in two steps:

- At first the brightness of the surface is calculated, from the frontside of the object as well as from it's backside. This is pretty much the same as in a normal render. Ambient-Occlusion, Radiosity, the type of diffuse Shader, the light color etc. is taken into account.
- In the second step the image is rendered finally, but now the SSS shader replaces the diffuse shader. Instead of the lamps the calculated lightmap is used. The brightness of a surface point is the calculated "Average" of the brightness of it's surrounding points. Depending on your settings the whole surface may be taken into account, and it's a bit more complicated than simply calculating the average, but don't bother too much with the math behind it.

Instead let's see what SSS does to a distinct light point.

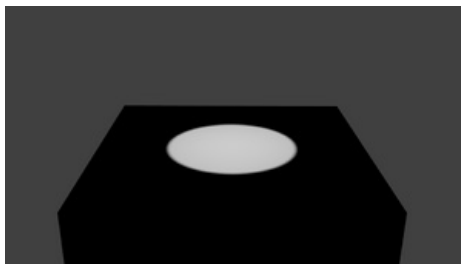


Image 3a: No SSS.



Image 3b: Small SSS radius.

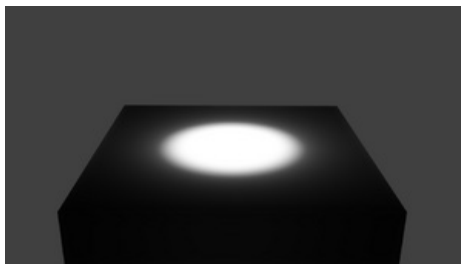


Image 3c: SSS radius enlarged.

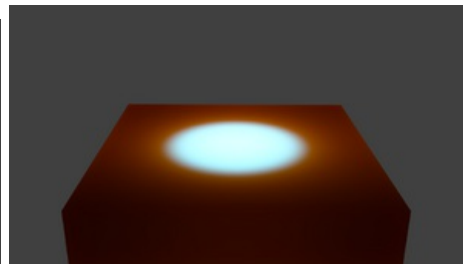


Image 3d: SSS with very large red radius value.

If you turn on SSS the light is distributed over a larger Area. The size of this area depends on the radius values. Instead of distributing all colors with the same amount, you may choose different radius values for each of the RGB-Colors.

If you use a very large radius value for a color, its light is evenly distributed over the whole object.

Enabling Subsurface Scattering



Image 4: The SSS Panel.
SSS is already enabled.

- Enable SSS by clicking on the Subsurface Scattering button.
- Accessible at the top are various presets. Add new or remove old presets by clicking the + and - buttons. When you select a pre-set, the Radius values, the RGB Radius and the IOR are set for you. The remaining options are not set (because they are mostly dependent on the size of your object).

SubSurface Scattering doesn't need raytracing. But since it is dependent on the incident light and shadows, you need proper shadow calculation (which may need raytracing).

Options

The numeric sliders control how the light is scattered:

IOR

The Index Of Refraction value determines the falloff of incident light. Higher values means that light falls off faster. The effect is quite subtle and changes the distribution function only a little bit. By the examination of many different materials a value of **1.3** to **1.5** have been found fitting. If you know the exact material you are trying to simulate, see [our IOR table](#).

Scale

The scale of your object, in Blender units, across which you want the scattering effect to take place. Scale 1.0 means **1** Blender unit equals **1** millimeter, scale **0.001** means **1** Blender unit equals **1** meter. If you want to work out what scale value to use in your scene, just use the formula: (size in blender units)/(real world size in millimeters)=scale.



The SSS Color Swatch

<Swatch>

The color swatch has two effects.

1. If you think of the SSS as a strange sort of lamp, this would be the lights color.
2. It also affects the scattering — the darker the color the more light is scattered.

So if you set it to green, the lit areas of the object will appear as green, and green is scattered only a little. Therefore the darker areas will appear in red and blue. You can compensate the different scattering by setting a larger radius for the color.

RGB Radius

The light blurring radius. As the light travels through the object and back up to emerge from the surface at some other point, it creates a path length. These sliders allow you to adjust the average length of that path. The longer the path length is, the more evenly this color is distributed.

Blend

Color

This controls how much the R, G, B option modulates the diffuse color and textures. Note that even with this option set to **0.0**, the R, G, B option still influences the scattering behavior.

Texture

How much the surface texture is blurred along with the shading.

Scattering Weight

Front

Factor to increase or decrease the front scattering. When light enters through the front of the object, how much is absorbed or added? (Normally **1.0** or **100%**).

Back

Factor to increase or decrease the back scattering. Light hitting an object from behind can go all the way through the object and come out on the front of the object. This happens mostly on thin objects, like hands and ears.

Error

This parameter controls how precisely the algorithm samples the surrounding points. Leaving it at **0.05** should give images without artifacts. It can be set higher to speed up rendering, potentially with errors. Setting it at **1.0** is a good way to quickly get a preview of the look, with errors.

Developing your own SSS material

Follow these simple steps to make your own SSS material:

- Set the SSS color on a value of your choice, normally the predominant color of the object. If you want to use different radiuses for the colors, don't make it too dark.
- Set the scale factor. If you want to see much translucency you need small objects or large scale values.
- Set the radius values.
- Adjust the brightness with the Front and Back values.

Examples

Skin



See also

- [Development Release Log: Subsurface Scattering](#)
- [Ben Simonds: Three Layer SSS in Blender Demystified](#)

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: [X](#)

done

Strands

The Strand section of the Material editor is specific to the rendering of Hair particles. There are two different strand methods available:

- **Polygon strands:** This is the default (old) method. The strands are rendered as flat polygons. The number of polygons depend on the Steps settings in the Render panel of the Object context, Particles sub-context.
- **Strand Primitive:** You activate Strand Primitive with the button Strand render in the Render panel of the particle system. The hair curves are not stored as polygons, but only the key points, which are then converted to polygons on the fly. A second difference is the way transparency works. Rather than rendering them using the existing system, all strand segments in a part are sorted front to back and rendered in that order.

Strand Primitives

- Are more memory efficient and faster, to make rendering of large amounts of fur and grass possible. For good performance, the render steps button should be lowered (e.g. 2 should be good enough fur), since the result will be a smoothed curve anyway. You need 1 to 2 render steps less than steps in the 3D window. Also, using more render parts helps to reduce memory usage.
- Have a distance of vision reduction (in the Render panel under Child Simplification) for children from faces.
- May be faded out towards the tip without an additional texture.
- Are not raytraced. So they are not visible through raytransparent materials or in a raymirror (you can use *Environment Mapping* for that).
- Have shape problems if they are rendered with a greater width.
- Can not carry an UV-Texture along the strand.

Polygon strands

- Work well with greater width, so you can use them as an alternative to billboards because the strands may have an animated shape.
- Can be textured with an UV-Texture along the strands.
- Are seen by raytracing.

Strands Shading

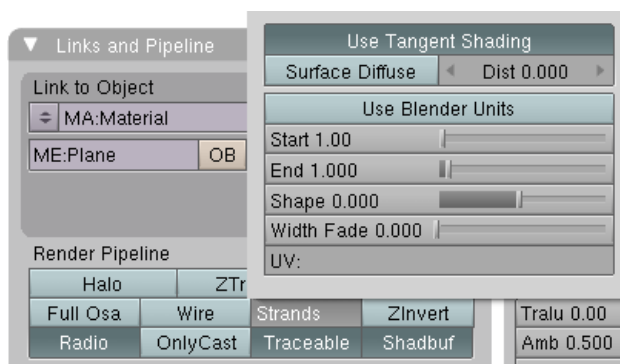


Image 1: Strands shader settings.

Strands are rendered with the material of the underlying face/vertex, including shading with an UV-Texture. Since you can assign more than one material to each face, each particle system may have it's own material and the material of the underlying face can be different from the material of the strands.

Additionally strands can be shaded along the strand (from root to tip) with a mono-dimensional texture, only polygon strands can carry a two-dimensional UV-Texture.

The options for the strand shading are in the Strands section of the Material context.

Root

Width of the hair at the root.

Tip

Width of the hair at the tip.

Minimum

This is the minimum thickness (in pixels) of the strands. Strands below that size are not rendered smaller, but are faded to alpha (well, the fading works only for strand primitives). This gives a much better rendering result for thin hair.

Blender Units

Normally strands are quite thin, the thickness is given in screenpixels. If you use Blender units (BU) you may set the root value up to 2 BU, the tip value up to 1 BU. You have to consider the overall object size, because the smallest possible size is 0.001 BU. So if you use 1 BU for 1 meter the smallest possible size would be 1 mm (too thick for thin hair).

Use Tangent Shading

Calculates the light as if the strands were very thin and round. This makes the hair appear brighter and shinier. Disabling the "Tangent Shading" option will still render nicely, but resembles more solid strands, as though made of metal or wood.

Shape

This slider allows you to control the interpolation. Default (0.0) is a linear interpolation between Root and Tip. A negative value will make the strand narrower (spiky), a positive value will make it fatter.

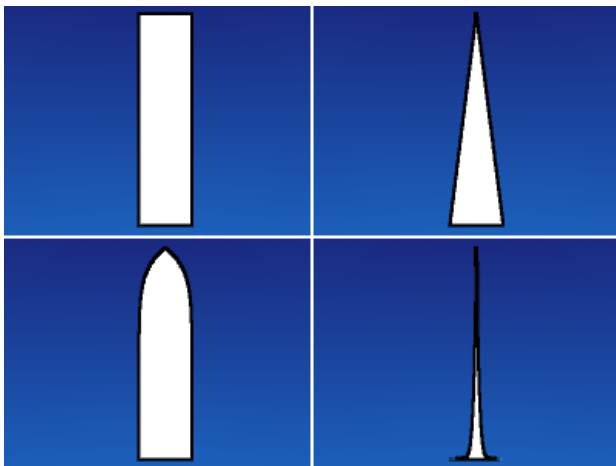


Image 2: a) Root=Tip, b) Tip=0.0, Shape=0.0, c) Shape=0.9, d) Shape=-0.9.

Width Fade

To fade out along the width of the strand. This works only for Strand Primitives. 0.0 is no fading at all, 1.0 linear fading out.

UV Layer

You can texture the polygon strands with an UV-Texture. Fill in the name of the UV-Set (not the texture) here. You have to load the texture also in the Shading context, Texture and Material sub-contexts (Mapping: UV; you may use every Influence setting you like - especially the alpha value, see *Image 3*).

Surface Diffuse

Computes the strand normal taking the normal at the surface into account. This eases the coloring and lighting of hair a lot, especially for Strand Primitives. Essentially hair reacts similar like ordinary surfaces and don't show exaggerated strong and large specular highlights.

Distance

The distance in Blender units over which to blend in the normal at the surface (if you want to use Surface Diffuse only for Grass/Fur in greater distance).

Texturing along the Strand

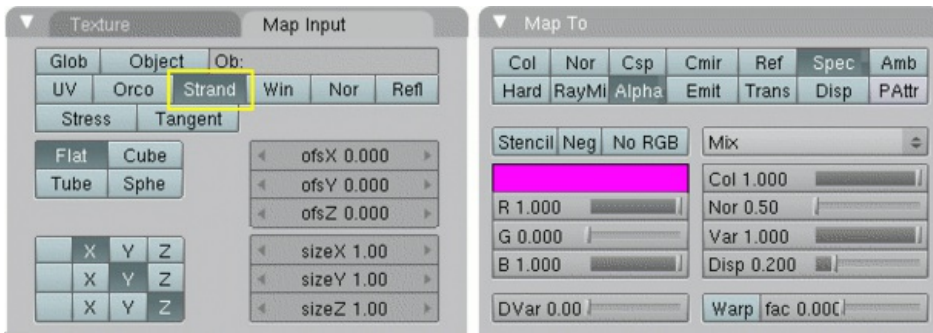


Image 4: Fading a strand to alpha...



Image 5: ...And the render result.

Strands can be textured along the strand, i.e. from root to tip. To do that you have to select Strand/Particle in the Coordinates dropdown in the Mapping panel of the Material sub-context.

Pretty much the most important setting is shown in (*Image 4*), how to fade the tip of a strand to alpha to make nice, fuzzy looking hair. Normally you would use a linear blend texture for this.

You may of course set any attribute you like, especially color. Be careful with specularly, hairs tend to get to shiny.

Strand render Simplification

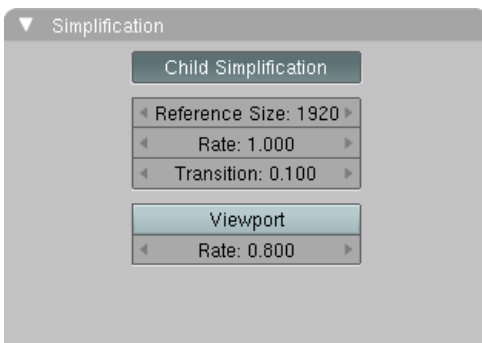


Image 5: Strand render child simplification.

If you use Strand Primitives (Strand render button) and have activated Interpolated Children, the Child Simplification option appears. The strand render has options to remove child strands as the object's faces become smaller.

Reference Size

This is the approximate size of the object on screen (in pixels), after which simplification starts.

Rate

How fast strands are removed.

Transition

The transition period for fading out strands as they are removed.

Viewport

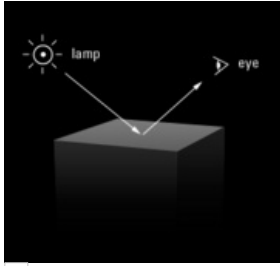
This removes strands on faces that are outside of the viewport.

Rate

Controls how fast these are removed.

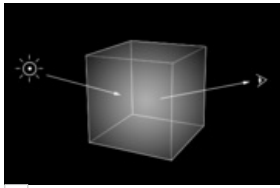
Volume Rendering

Volume rendering is a method for rendering light as it passes through participating media, within a 3d region. The implementation in Blender's sim-physics branch is a physically based model, which represents the various interactions of light in a volume relatively realistically.



Solid rendering

The process of rendering a solid surface involves the camera finding a piece of geometry, then calculating the light that bounces from light sources (lamp objects, or other geometry), off the surface, and towards the camera. The light that arrives at the camera is the final colour that's rendered.



Volume rendering

Rendering a volume works differently. Light enters a 3D region of space (defined as the volume) that may be filled with small particles, such as smoke, mist or clouds.

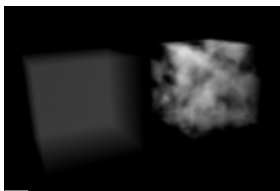
The light bounces around off the various molecules, being scattered or absorbed, until some light passes through the volume and reaches the camera. In order for that volume to be visible, the renderer must figure out how much material the light has passed through and how it has acted and reacted within that volume, the volume object needs to contain a 3D region of space, for example a watertight closed mesh, such as a cube, not just a flat surface like a plane. To get an image, the renderer has to step through that region, and see how much 'stuff' is there (density) in order to see how light is absorbed or scattered or whatever. This can be a time consuming process since it has to check a lot of points in space and evaluate the density at each.

Texturing Volumes

Use the [Voxel Data](#) texture to add color information to the volume.

Options

Density



Constant density vs textured density

Many things can happen to the light as it passes through the volume, which will influence the final colour that arrives at the camera. These represent physical interactions that happen in the real world, and most of these are dependent on the density of the volume, which can either be a constant density throughout, or varied, controlled by a texture. It is by controlling the density that one can get the typical 'volumetric' effects such as clouds or thick smoke.

Density

The base density of the material - other density from textures is added on top

Density Scale

A global multiplier to increase or decrease the apparent density. This can be useful for getting consistent results across different scene scales.

Shading

Scattering



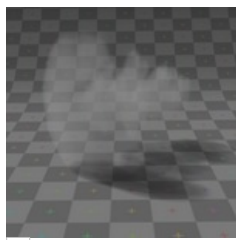
Spot lamp scattering in a constant volume

When light enters a volume from an external source, it doesn't just pass straight through. Light gets deflected off tiny particles in the volume, and some proportion of that light reaches the camera. This property makes it possible to see light beams as they travel through a volume and are scattered towards the eye.

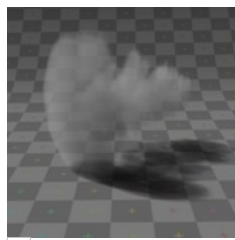
Scattering

The amount of light that is scattered out of the volume. The more light that is scattered out of the volume, the less it will penetrate through the rest of the volume. Raising this parameter can have the effect of making the volume seem denser, as the light is scattered out quickly at the 'surface' of the volume, leaving the areas internal to the volume darker, as the light doesn't reach it.

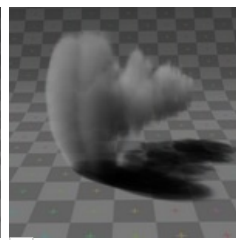
Note in the examples below, the less light that is scattered out of the volume, the more easily it penetrates throughout the volume and to the shadow.



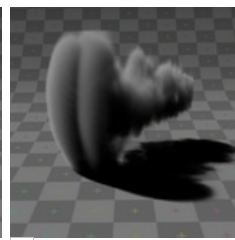
Scattering: 0.5



Scattering: 1.0

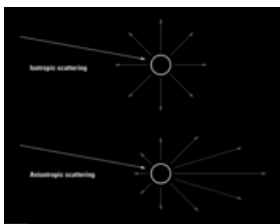


Scattering: 2.0



Scattering: 5.0

Asymmetry



Isotropic and Anisotropic scattering

The default method for scattering light in a volume is for the light to be deflected evenly in all directions - known as Isotropic scattering. In real life different types of media can scatter light in different angular directions, known as Anisotropic scattering. Back-scattering means that light is scattered more towards the incoming light direction, and forward-scattering means it's scattered along the same direction as the light is travelling.

Asymmetry

Asymmetry controls the range between back-scattering (-1.0) and forward-scattering (1.0). The default value of 0.0 gives isotropic scattering (even in all directions).

Transmission

Transmission is a general term for light that is transmitted throughout a volume.

This transmitted light can be the result of various different interactions, for example:

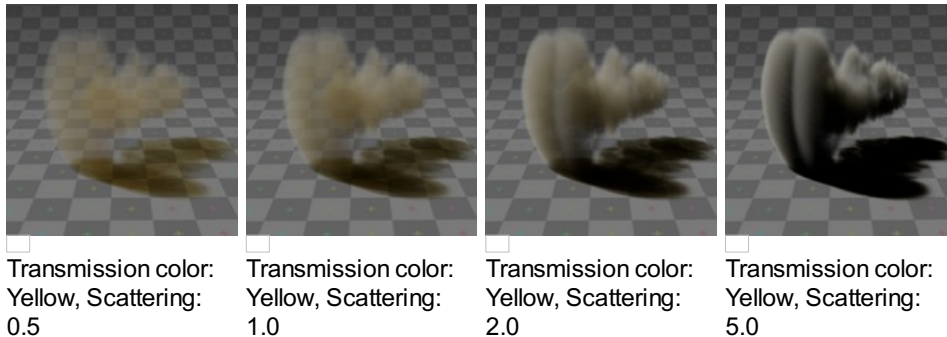
- the left over result of incoming light after it has reflected/scattered out of the volume
- the left over result of light after being absorbed by the volume (and converted to heat)

Here, the transmission colour is used to set the end result colour that light becomes after it is transmitted through the volume.

Transmission Color

The resultant colour of light that is transmitted through the volume.

Note in the examples below, as more light is scattered out of the volume, there is less available to be transmitted through.



Emission

Some volumes can emit light where there was none before, via chemical or thermal processes, such as fire. This light is generated from the volume itself and is independent of light coming from external sources.

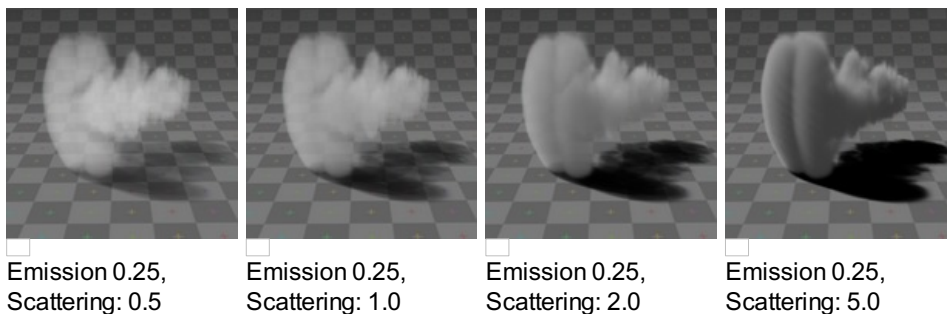
Currently, this emitted light does not affect other volumes or surfaces (similar to surface material type, 'Emit' option).

Emission Color

The colour of light that is emitted by the volume.

Emission

An intensity multiplier for the emitted colour, for scaling up and down.



Reflection

The 'reflection' parameters can be used to tint or scale the light that's scattered out of the volume. This only affects light that has come from lamps and been scattered out, it doesn't affect the colour of transmitted or emitted light and is .

These settings are not physically correct because they don't conserve energy - the light scattering out doesn't affect the remaining light that is transmitted throughout the rest of the volume. For example, physically speaking, if the orange components of the light are scattered out of the volume towards the camera, only the inverse of that (blue) will remain to continue penetrating through the volume, causing the volume to take on a multi-coloured appearance, which can be difficult to use. To make it a bit easier to plainly set the colour of the volume, you can use the reflection parameters to quickly set an overall tint.

Reflection Color

The colour of light that is scattered out of the volume.

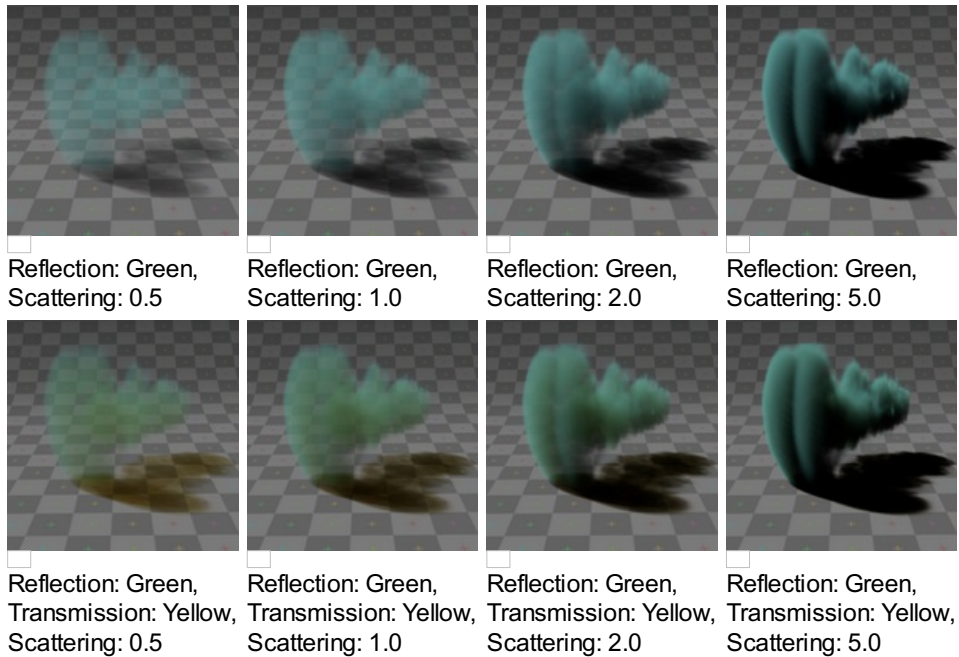
Reflection

An intensity multiplier for the reflection, for scaling up and down.

Hints

Ideally try to accomplish as much as you can with the other volume settings and lighting before using the reflection controls. If you stick to what's physically plausible, the material will act correctly, and be more predictable and usable in a wider range of lighting scenarios.

Of course you can always break the rules too!



Lighting

Several shading modes are available, providing a range of options between fast to render and physically accurate.

Lighting Mode

Shadeless

Shadeless is the simplest, useful for thin, wispy mist or steam.

Shadowed

Shadowed is similar, but with shadows of external objects.

Shaded

Shaded uses a volumetric single-scattering method, for self-shading the volume as light penetrates through.

Multiple Scattering

Allows multiple scatter calculations.

Shaded+Multiple Scattering

Combines Shaded and Multiple Scattering functionality.

Shaded Options:

External Shadows

Receive shadows from sources outside the volume (temporary).

Light Cache

Pre-calculate the shading information into a voxel grid, speeds up shading at slightly less accuracy.

Resolution

Resolution of the voxel grid, low resolutions are faster, high resolutions use more memory.

Multiple Scattering Options:

Diffusion

Diffusion factor, the strength of the blurring effect.

Spread

Proportional distance over which the light is diffused.

Intensity

Multiplier for multiple scattered light energy.

Transparency

Mask

Mask the Background.

Z Transparency

Use Alpha buffer for transparent faces.

Raytrace

Use Raytracing for Transparent Refraction rendering.

Integration

Step Calculation Method

...

Randomized

...

Constant

...

Step Size

Distance between subsequent volume depth samples. Step Sizes determine how noisy the volume is. Higher values result in lower render times and higher noise.

Depth Cutoff

Stop ray marching early if transmission drops below this luminance - higher values give speedups in dense volumes at the expense of accuracy.

Options

Traceable

Allow this material to calculate raytracing.

Full Oversample

Force this material to render full shading/textures for all anti-aliasing samples.

Use Mist

Use mist with this material (in world settings).

Light Group

Limit lighting of this material to lamps in this group.

Exclusive

Material uses this group exclusively. Lamps are excluded from other scene lighting.

Examples

<these are sandbox edits to the whole shading intro section of the wiki, which groups materials and textures, and gives us an entree into Volumetric shading. Note qualification of Mesh object. Need to investigate shading of other object types...>

Shading is the process and the code which enables an object to be seen in the final render output. Blender has four methods to shade a mesh object:

1. Surface
2. Volumetric
3. Halo
4. Wire

Surface shading indicates that the object is a tangible, skinned object that has a solid (but possibly pliable) surface, such as a chair, a sword, or a peach. The surface is described in terms of having a diffuse, specular, mirror, and transparency. It may also have a semi-transparent surface and something inside of it that scatters light, called sub-surface scattering. It may be reflective, such as chrome, smooth plastic, or metal, and may be partially transparent, such as glass, or liquid.

Volumetric shading treats the object as a volume of space that is filled with microscopic particles, such as a cloud, smoke, mist, fog, mystical spells, and steam. As light enters the volume, it is scattered by these particles, and some of that scattering reaches the eye/camera for us to see. The volume is described in terms of density, xxx. The particles may be uniformly colored but have a varying density within the volume, and so the shape may have darker areas. The density may be uniformly dispersed throughout the volume, or it may be clumped, giving a recognizable shape. Those microscopic particles may give off light themselves, as if they contained glowing embers or sparks, or were transmitting some energy field inside the cloud. That density may be driven by a particle system to create a well-defined jet or emission.

Halo shading turns each vertex of the object into a glob of light, an effect seen with sparks, pixie dust, glint, and sparkles from, for example, a diamond in bright sunlight. Halos can also be used to give a rough approximation of a lens flare, which is observed when a real camera lens looks directly at a bright light source such as the sun.

Wire shading renders each edge of the object as a thin line, like a wire cage, or net. Wire rendering is very fast and can be used as a proxy material for a more complicated surface to save time during intermediate renders.

There are two major components to shading: the Material and its Textures. The color that you see is a function of the light and the shading, so you need to also check out the lighting section as well. There are five types of objects in Blender that can be shaded: Mesh, Curve, Surface, Meta, and Text. The table below indicates which types of shading are available for each kind of object. Keep in mind that all types of non-mesh objects can be converted from their type to a Mesh, so, ultimately, all kinds of shading are available for

all kinds of objects

Shading available per Object type				
	Surface	Halo	Wire	Volumetric
Mesh	yes	full	yes	yes
Curve	if cyclic or extruded	no	no	
Surface	yes	no	yes	
Meta	yes	no	no	
Text	yes	no	no	

Options

Introduction

In addition to creating materials as just described using all the settings on all the materials panels, Blender allows you to create a material by routing basic materials through a set of nodes. Each node performs some operation on the material, changing how it will appear when applied to the mesh, and passes it on to the next node. In this way, very complex material appearances can be achieved.

You should already be familiar with general material concepts and how to create materials/textures using the material menu. You should also have a general understanding of the texture coordinate systems available in Blender (e.g. Generated, UV, etc.). Also, many aspects of a node will be skipped here because in later sections you will see the function expanded upon. Each section builds off the previous.

To start, the node system does not make the material menu obsolete. Many features and material settings are still only accessible through the material panel (e.g. Ray Mirror). However with the advent of nodes, more complex and fantastic materials can be created since we now have greater control.

Just in case you're not (yet) familiar with the concepts: when you create a system of nodes (otherwise known as a "noodle"), you're describing a data-processing pipeline of sorts, where data "flows from" nodes which describe various *sources*, "flows through" nodes which represent various processing and filtering stages, and finally "flows into" nodes which represent outputs or destinations. You can connect the nodes to one another in many different ways, and you can adjust "knobs," or parameters, that control the behavior of each node. This gives you a tremendous amount of creative control. And, it will very quickly become intuitive.

Having said all that, let's begin with a normal material.

Here we have the standard material we have added to a cube mesh. We could, as we have in the past, add color and other settings to this material and it would certainly look nice. But let's say we are just not getting what we are looking for? What if we want to control the creation more tightly or add more complexity? Here is where nodes come in.

Making this node map is accomplished by working in a [Node Editor window](#). This section covers:

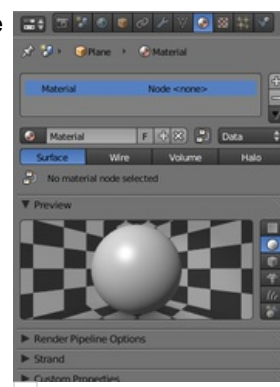
- Enabling Material Nodes.
- The Node Editor window, its basic controls, and working with nodes.
- The specific types of nodes available for materials.

Accessing The Node Editor

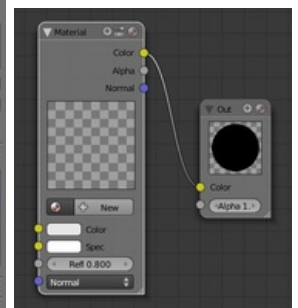
First lets enter the [node editor](#) and make sure that the node editor has the material node button (the sphere icon) pressed, not the composite or texture node buttons.

Enabling Node Materials in the Material Buttons

Let's take the base material and hit the Nodes button next to the material name in the material panel or the node editor. You will see a change in the material panel.

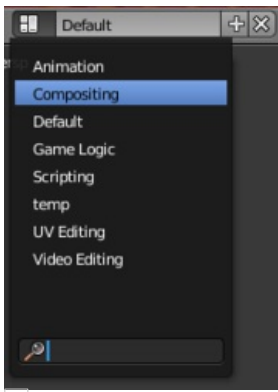


Material's menu with Nodes enabled



Default nodes

What you have just done is told Blender to make the material you were on to become the node tree. Most of the panels we normally find in the material menu are now gone.



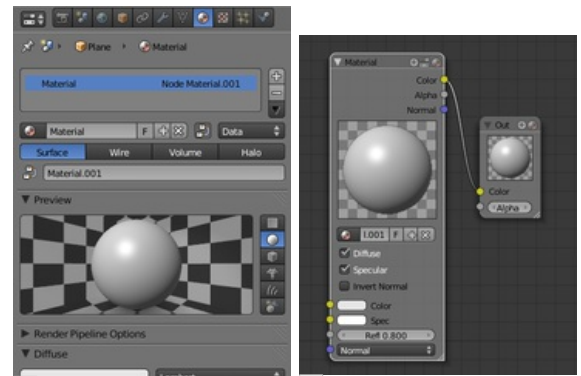
Accessing the Compositing screen

If you switch to the Compositing screen (Ctrl← if you are on the default screen) you'll find a Node Editor on the top half of the screen. When you enabled material nodes, a material node and an output node were automatically added to the node editor.

You can also split the 3D view in the default screen in two and change one into a Node Editor.

It is important to note that you can add a new material (which you can edit and change like any other material in the material panel), add an already created material or append a material from another blender file, and also use the material that you used to create the node tree.

Here, we added a new material in the Node editor (*Material.001*), and as we did, we can access the properties of this material in the material's menu.



Material's menu with a first material added to the Node Editor

External Links

- [Blender Material Nodes](#) - Changelog for the Blender version that introduced material nodes.

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Proposed fixes: none

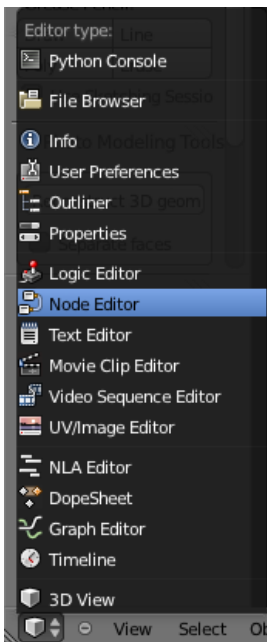
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Proposed fixes: none

The Node Editor

This section explains the window in general, and its header menu options. It also tells you how to enable nodes for use within Blender.

Accessing The Node Editor



Select the Node Editor window.

First let's enter the node editor by changing our window type to Node Editor. As shown in *Select the Node Editor window*, click on the window type icon and select Node Editor from the popup list. Node maps can get quite large, so use or create a big window. The window has a graph-paper style background and a header.

Each scene within your blend file can have multiple Material Node map and ONE Compositing Node map. The Node Editor window shows either map, depending on the selector position.

Hint

You might want to add a new window layout called 6-Nodes (the list is shown on the User Preferences header at the top of your screen) comprised mostly of one big Node Editor window. My layout has the buttons window at the bottom and a text editor window on the side for me to keep notes. If you have a widescreen display (or even a regular one), you might also want to add a 3D view or UV/Image Editor window to the left side of the Node window layout, so you can work with images or your model while you're manipulating nodes. Having the 3D Preview Render panel open on top of an object is quite useful if you're tweaking material nodes.

By default, the header, when first displayed, is uninitialized as shown:



Default Node Editor header.

Activating Nodes

- What nodes to use?
 - If you want to work with a material node map, click the ball in the Material/Compositing node set selector. (see *Node Editor Header with Material Nodes enabled.*)
 - If you want to work with a compositing node map, click the face on the Material/Compositing node set selector. (see *Node Editor Header with Compositing Nodes enabled.*)
- To actually activate nodes, click the Use Nodes button.
- The first time that you select either a Material or a Compositing node map, the Node Editor window will be instantly filled with starter input and output compositing nodes already connected together.



Node Editor Header with Material Nodes enabled.



Node Editor Header with Compositing Nodes enabled.

Node Editor Window Actions

When the cursor is in the window, several standard Blender hotkeys and mouse actions are available, including:

Popup menu

Space - Brings up a main popup menu, allowing you to add, view, select, etc.

Delete

X or Del - Deletes the selected node(s).

Box select

B - Starts the bounding box selection process. Position your cursor and LMB click & drag to select a set of nodes.

Cut connections (box)

LMB click & drag - Starts a box selection, BUT when you let up the mouse button, all threads (connections) within the box are broken.

Undo

CtrlZ Very helpful if you forgot to press B before box-selecting, eh?

Redo

CtrlY or Ctrl⇧ ShiftZ - You can use this if you used "undo" a bit to often :)

Select multiple

⇧ Shift LMB or ⇧ Shift RMB - Multiple node select.

Grab/Move

G - Moves your current selection around.

Execute

E - pumps inputs through the noodle, refreshing everything.

Standard Window Control

Node maps can get pretty hairy (large and complicated, that is). The contents of the window, (the node map) can be panned just like any other Blender window by clicking MMB and dragging about. Wheeling Wheel up/down or using the keypad + NumPad/- NumPad will zoom in/out. The window can be resized and combined using the standard window techniques (see *Navigating in 3d Space*).

Node Editor Header

At a glance

On the window header, you will see header options:

- View - to see things more clearly;
- Select - to do things more clearly;
- Add - to walk with...err..to add Nodes, organized by type;
- Node - to do things with selected nodes, akin to vertices;

- a Material or Compositing node set selector;
- a Use Nodes button;
- a Free Unused button.



Node Editor Header with Material Nodes enabled.



Node Editor Header with Compositing Nodes enabled.

Menus

View, Select and Add

These popup menus provide the basic functions:

View

This menu changes your view of the window, standing in for the standard keyboard shortcuts + NumPad (zoom in), - NumPad (zoom out), ⌘ Home (zoom all) or equivalent mouse actions.

Select

This menu allows you to select a node or groups of nodes, and does the same as typing the hotkey to select all A or start the border select B process.

Add

This menu allows you to add nodes. Please see the next section for a discussion on the types of nodes that you can add, and what they do. Clicking this menu item is the same as pressing Space when the cursor is in the window

Node

Show Cyclic Dependencies

C - Ok, so you've been adding and connecting nodes to your heart's content, and you haven't run out of memory yet. Selecting Show Cyclic Dependencies will show you where you have connected your threads in a circle. For example, you can easily connect a mix output as input to another node, and then connect that node's output back to the mix node input, resulting in a little circle where the image just runs round and round. Left alone, it will eventually get tired and dizzy and crash your computer.

Hide

H - Hides your selected nodes. Just like vertices in a mesh.

Grouping

Most importantly, this menu option allows you to create a user-defined group of nodes. This group can then be edited and added to the map. To create a group, select the nodes you want, and then Node → Make Group, or just use the keyboard shortcut CtrlG. Edit the name using the little input box in the group. Groups are easily identified by their green header and cool names you have picked for them.

Delete

X - Deletes selected nodes.

Duplicate

⇧ ShiftD - Makes an Unlinked copy, with the same settings as the original.

Grab

G - Moves the little nodes around according to your mouse, just like with meshes.

Duplicate - Faked you out

The new copy is placed **exactly over the old one**. But it isn't the connected one, so playing with the controls will do nothing to your images, even though it **looks** like it's connected with the little threads coming out of the node that is **underneath**. You have to move the duplicated node to reveal the connected node beneath it.

Grab - Reminder Only

Just like my mother-in-law, the menu item does not actually do anything; it's just there to remind you that you can press the G key when your cursor is in the window and actually accomplish something with your life (like rearranging nodes in the window).

Buttons

Material/Composite Selector

Nodes are grouped into two categories, based on what they operate on:

- to work with [Material Nodes](#), click on the ball,
- to work with [Compositing nodes](#), click on the face.

Use Nodes Button

This button tells the render engine to use the node map in computing the material color or rendering the final image, or not. If not, the map is ignored and the basic render of the material tabs or scene is accomplished.

Free Unused Button

This button frees up memory space when you have a very complex node map. Recommended.

Backdrop

Use the active viewer node output as a backdrop. When enabled, additional settings appear in the Header and the Properties Panel:


Backdrop Channels

Set the image to be displayed with Color, Color and Alpha, or just Alpha.

Zoom

Sets how big the backdrop image is.

Offset

Change the screen space position of the backdrop, or click the Move button, or shortcut Alt MMB  to manually move it.

Auto Render

Re-render and composite changed layer when edits to the 3d scene are made.

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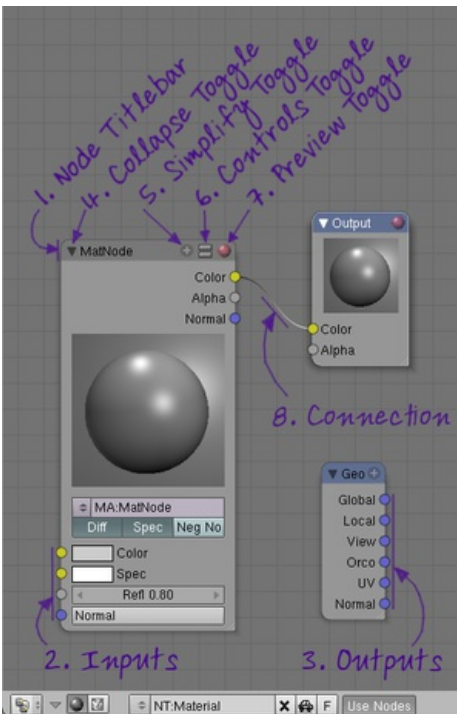
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Proposed fixes: none

Node Controls

This page explains the widget to control a node.



Nodes main controls

Titlebar

This contains the node's name, along with several different collapse buttons.

Input sockets

The left side of a node has input sockets:

- *blue sockets* accept vectors
- *yellow sockets* accept colors
- *grey sockets* accept single values (like alpha)

Output sockets

The right side of a node has output sockets:

- *blue sockets* produce vectors
- *yellow sockets* produce colors
- *grey sockets* produce single values (like alpha)

Image preview / Curve

Inside the node there's an area to show the image preview being output by the node or the curves that control the node behaviour (for example in a RGB node).

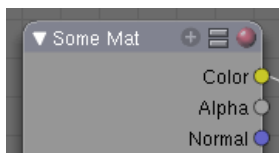
Buttons and menus

Below the image preview there are buttons and menus to control the node behaviour.

Threads

A curved line shows a connection from an output socket to an input socket. The socket types must match. Connections associated with the active node are highlighted for better visibility.

Collapsing toggles



Top of a Node.

At the top of a node there are up to 4 visual controls for the node (*Top of a Node*). Clicking these controls influences how much information the node shows.

Node toggle (▼ ►)

The arrow on the left collapses/uncollapses the node.

Sockets toggle (+ +)

The plus-sign button on the right side of the titlebar hides/unhides unused input/output sockets

Menu toggle (≡)

The double-line button in the middle right hides/unhides all of the interface controls.

Preview image toggle (●)

The sphere button on the far right of the titlebar hides/unhides preview image. If the Sphere is **red** this can have 3 reasons:

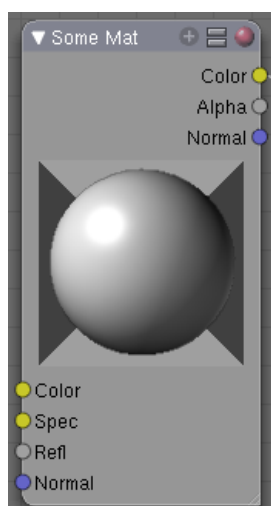
- it's the only effective output node in the node editor.
- it's a [Material input node](#) that has a Material (MA:) assigned to it.



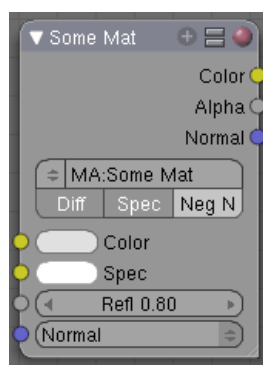
Collapsing Arrow.



Plus Sign.



Menu Collapse.

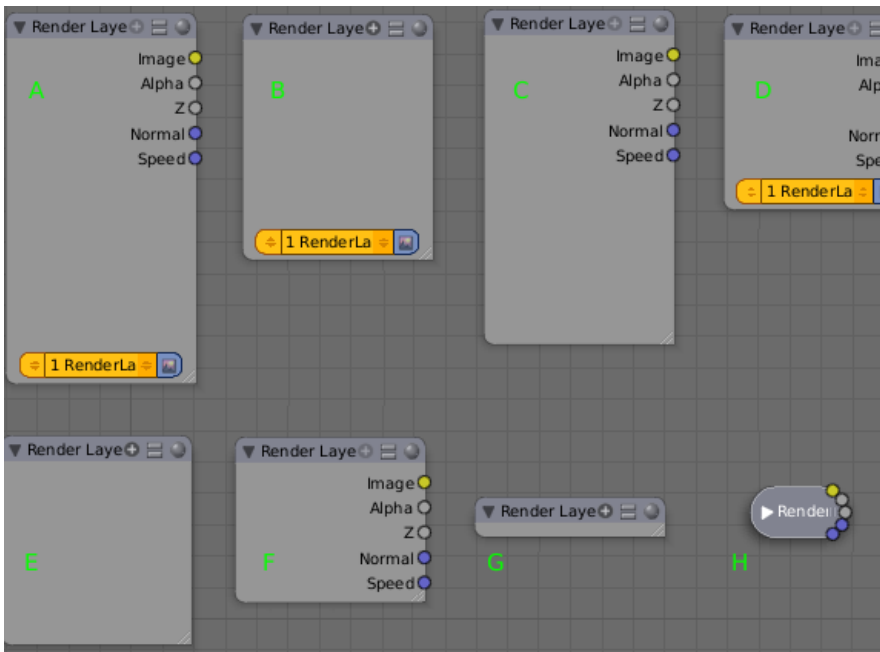


Sphere.



In Combination.


The later three can be used in varying combinations with each other. The arrow that collapses the entire node can only be used in combination with the plus sign (*In Combination*).



Top sizing controls of a Node

A) Normal, B) + Sign clicked, C) = Sign clicked, D) Sphere clicked, E) + and = clicked, F) = and Sphere clicked, G) All three clicked H) Arrow clicked.

Sizing the node

Fine Sizing of an individual node can also be accomplished somewhat by clicking LMB  and dragging in the lower right-hand corner (where the little slanted lines are).

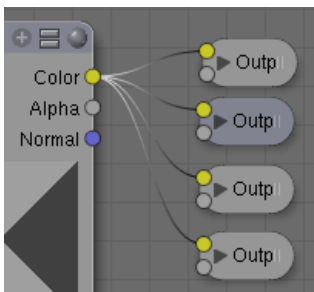
Sockets



Node Sockets.



Each Node in your node window will have "sockets" (often also referred to as "connectors") which are small colored circles to which input data and output data will be linked (*Node Sockets*).

The sockets on the left side of a node describe *inputs*, while the sockets on the right side are *outputs*.



Node Linking.

For your convenience, nodes are *color-coded* according to the type of information they expect to send or receive. There are three colors:

-  Yellow sockets
Indicates that **color** information needs to be input or will be output from the node.
-  Grey sockets
Indicates values (**numeric**) information. It can either be a single numerical value or a so-called "value map." (You can think of a value map as a grayscale-map where the different amount of bright/dark reflects the value for each point.) If a single value is

used as an input for a "value map" socket, all points of the map are set to this same value.
Common use: Alpha maps and value-options for a node.

 Blue/Purple sockets
Indicates **vector/coordinate/normal** information.

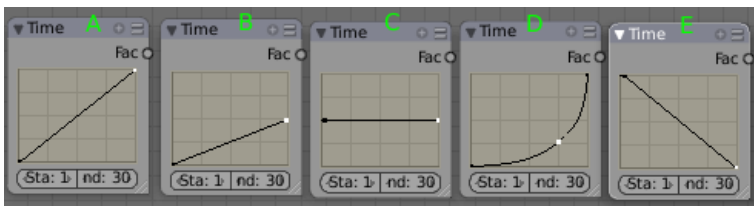
Between nodes, yellow must be linked to yellow, gray to gray, blue to blue, unless you use a *converter*, which we'll cover later on.

Next to the color in the node you will see the name of that socket. Though not always the case, you can see the name of the socket as what the information is *intended* to be. But this is not necessarily what it *has* to be. For example, I can add a link from an gray socket titled Alpha to the material node's gray Reflection socket and still get a result, the key thing being that it's a "gray to gray" connection.


There are exceptions where you can mix yellow (e.g. a color-image) and gray (e.g. grayscale) without converters. Blender normally places a converter if needed, so feel free to experiment with them. You can use the "Viewer" output nodes, as explained in the later sections, to see if/how it works.

Curves

Some nodes have a curve area that translates an input value to an output value. You can modify this curve shape by clicking on a control point and moving it, or adding a control point. Some examples are shown below:



Modifying a curve node.

Every curve starts out as a straight line with a slope of 1. (My daughter NEVER thought she would use her high school algebra. Ha!) The curve starts out with two tiny black control points at each end of the line. Clicking LMB  on a control point selects it and it turns white.

Changing the curve affects how the output is generated. The input, X, usually proceeds linearly (at regular intervals) across the **bottom** axis. Go up until you hit the curve, and then over to the **right** to determine the Y output for that corresponding X. So, for the second example, as X goes from 0 to 1.0 across the bottom, Y varies from 0.0 to 0.5. In the third, as X goes from 0.0 to 1.0 across the bottom, Y stays constant at 0.5. So, in the picture above, these curves have the following affect on time: **A** don't affect, **B** slow down, **C** stop, **D** accelerate, and **E** reverse time.

The "Curves" widget is a built-in feature in Blender's UI, and can be used anywhere, provided the curve data itself is being delivered to this widget. Currently it is in use in the Node Editor and in the UV Window.



This widget will map an input value horizontally and return the new value as indicated by the height of the curve.

Note: The fact that one of the points on the curve is "white" in each of these screen-shots is *not* significant: it just means that it happened to be the point most-recently selected by your author when preparing this tutorial. What matters here is the shape of *the* curve, not the position (nor the color) of the control-points that were used to define it.





RGB Curves

Multiple curves can be edited in a single widget. The typical use, RGB curves, has "Combined" result or "Color" ("C") as the first curve, and provides curves for the individual R, G, and B components. All four curves are active together, the "C" curve gets evaluated first.

Selecting curve points


- LMB  always selects 1 point and deselects the rest.
- Hold  Shift while clicking to extend the selection or select fewer points.

Editing curves

- LMB  click&drag on a point will move points.
- A LMB  click on a curve will add a new point.
- Dragging a point exactly on top of another will merge them.
- Holding  Shift while dragging snaps to grid units.
- Ctrl LMB  adds a point.
- Use the X icon to remove selected points.

Editing the view

The default view is locked to a 0.0-1.0 area. If clipping is set, which is default, you cannot zoom out or drag the view. Disable clipping with the icon resembling a #.

- LMB  click&drag outside of curve moves the view
- Use the + and - icons to zoom in or out.

Special tools

The wrench icon gives a menu with choices to reset a view, to define interpolation of points, or to reset the curve.

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Using nodes

Adding Nodes


Nodes are added in two ways to the node editor window:


- By clicking the Add menu in the node editor toolbar and picking the type of node you want, or
- By having your cursor in the node editor window and pressing Space and picking a node from the popup Add menu.

Arranging Nodes

In general, try to arrange your nodes within the window such that the image flows from left to right, top to bottom. Move a node by clicking on a benign area and dragging it around. The node can be clicked almost anywhere and dragged about; connections will reshape as a bezier curve as best as possible.



Connecting nodes

LMB -click and drag a socket: you will see a branch coming out of it: this is called a "thread".

Kepp dragging and connect the thread to an input socket of another node, then release the LMB .

In this case, a copy of each output is routed along a thread. However, only a single thread can be linked to an input socket.

Disconnecting nodes

To break a link between sockets LMB -click in an empty areas near the thread you want to disconnect and drag: you will see a little cutter icon appearing at your mouse pointer. Move it over the thread itself, and release the LMB .

Duplicating a node

Click on the desidered node, press ⇧ ShiftD and move the mouse away to see the duplicate of the selected node appeaing under the mouse pointer.

Gotcha!

When you duplicate a node, the new node will be positioned *exactly* on top of the node that was duplicated. If you leave it there (and it's quite easy to do so), you can **not** easily tell that there are *two* nodes there! When in doubt, grab a node and move it slightly to see if something's lurking underneath.

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Node Groups

Both material and composite nodes can be grouped. Grouping nodes can simplify the node network layout in the node editor, making your material or composite 'noodle' (node network) easier to work with. Grouping nodes also creates what are called NodeGroups (inside a .blend file) or NodeTrees (when appending).

Conceptually, "grouping" allows you to specify a *set* of nodes that you can treat as though it were "just one node." You can then re-use it one or more times in this or some different .blend file(s).

As an example: If you have created a material using nodes that you would like to use in another .blend file, you *could* simply append the material from one .blend file to another. However, what if you would like to create a new material, and use a branch from an existing material node network? You could re-create the branch. Or you could append the material to the new .blend file, then cut and paste the branch that you want into the new material. Both of these options work, but are not very efficient when working across different .blend files. What if you have created a "Depth of Field" composite node network and would like to use it in another .blend file? What if you wanted to apply exactly the same series of operations, dozens of times? Here again, you *could* re-create the network, but this is not very efficient. A better method of re-use, for either material node branches or composite node networks, would be to create groups of nodes.

Once a group has been defined, it becomes an opaque object; a reusable software component. You can (if you choose) ignore exactly how it is *defined*, and simply use it (as many times as you like) for whatever it *does*. Groups can be made available through the [Blender's library and standard appending method](#).

Grouping Nodes

Panel: [Node Editor](#)

Menu: ⇧ ShiftA → Groups

To create a node group, in the node editor, select the nodes you want to include, then press CtrlG or Space » node » make group. A node group will have a green title bar. All of the selected nodes will now be minimized and contained within the group node. Default naming for the node groups is *NodeGroup*, *NodeGroup.001* etc. There is a name field in the node group you can click into to change the name of the group. Change the name of the node group to something meaningful. When appending node groups from one .blend file to another, Blender does not make a distinction between material node groups or composite node groups, so I recommend some naming convention that will allow you to easily distinguish between the two types. For example, name your material node branches *Mat_XXX*, and your composite node networks *Cmp_XXX*.



What not to include in your groups (all types of Node editors)

Remember that the essential idea is that a group should be an easily-reusable, self-contained, software component. Material node groups should **not include**:

Source nodes

if you include a source node in your group, you'll end up having the source node appearing *twice*: once inside the group, and once outside the group in the new material node-network.

Examples of source nodes are: the *Material Node* (Material nodes editor) and the *Render Layers Node* (Composite Editor).

Output node

if you include an output node in the group, there won't be an output socket available *from* the group!

Examples of output nodes are: the *Output Node* (Material nodes editor) and the *Viewer Node* (Composite Editor).

Editing Node Groups

With a group node selected, pressing ⇆ Tab expands the node to a window frame, and the individual nodes within it are shown to you. You can move them around, play with their individual controls, re-thread them internally, etc. just like you can if they were a normal part of your editor window. You will not be able to thread them to an outside node directly from them; you have to use the external sockets on the side of the Group node. To add or remove nodes from the group, you need to ungroup them.

Ungrouping Nodes

The AltG command destroys the group and places the individual nodes into your editor workspace. No internal connections are lost, and now you can thread internal nodes to other nodes in your workspace.

Appending Node Groups

Once you have appended a NodeTree to your .blend file, you can make use of it in the node editor by pressing Space → Add → Groups, then select the appended group. The "control panel" of the Group is the individual controls for the grouped nodes. You can change them by working with the Group node like any other node.

Types of Material Nodes

This section is organized by type of node, which are grouped based on similar functions:

- [Input](#) - Introduces a material or component to the node map.
- [Output](#) - Displays the result in progress as a small image.
- [Color](#)- Manipulates the colors of the material.
- [Vector](#)- Change the way light is reflected off the material.
- [Convertors](#)- Convert colors to other material colors.
- [Groups](#)- User-defined groups of nodes.
- [Dynamic](#)- Custom nodes defined by Python. These are also known as PyNodes.

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Material Input Nodes

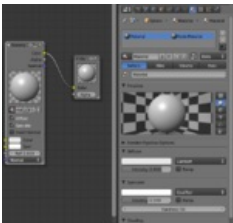
A starting material is created in the Materials Panel. The Nodes button is enabled to add that material to the list of noded materials shown in the Node Editor window header. Other inputs to the node map include:

- A value
- A color
- A texture
- Geometry
- Material
- Camera Data

Material Node

Panel: [Node Editor](#) → [Material Nodes](#)

Menu: ⇧ ShiftA → [Input](#) → Material



Material node

The Material node is used to add a material to the node program. Materials can be anything from pure shading to fully layered with textures. It inputs the main attributes of a material (color, alpha and normal vector) into the map.



Output

Materials can output color (which includes shading and any textures assigned to it), alpha, and the final normal calculated from any textures it has.

- Color
- Alpha
- Normal

Input

Materials can take inputs for colors, inputs for diffuse color and specular color, a value for reflectivity, and a normal.

- Color - The base color of the paint. Can be set
 - manually by LMB  clicking on the color swatch applet next to the socket, choosing a color using the control panel that pops up, and pressing ↵ Enter
 - based on an Active Material which is specified using the material panels, or
 - plugged in from an RGB color generator.
- Spec - The color that is reflected as you get perpendicular to the light source reflecting off the surface. The color can be
 - plugged in from another node or
 - set manually by LMB  clicking on and using the color swatch applet.
- Refl: - The degree to which the material reflects light and gives off its color. The value can be provided by another node or set manually.
- Normal - The lighting condition.

Controls

MA:Material field

You can browse and select materials here.

Diff toggle

Turn on/off Diffuse Color.

Spec toggle

Turns on/off Specularity calculation.

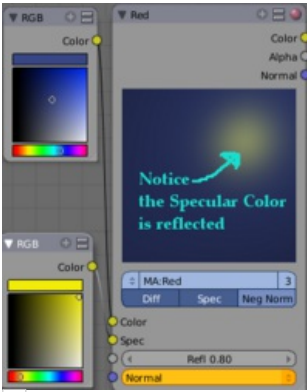
Neg toggle

Inverts the material input normal when activated (which, of course, is a combination of the 3D normal given to it by the 3D object plus the normal input point).

Normal Override

The normal input socket does not in any way blend the source normal with the underlying geometry. Any plugged in Geometry here overrides the Normal lighting conditions.

Using the Material Node with Specularity



Material Node using
Specularity

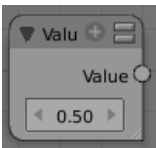
To make a material node actually generate a color, you have to specify at least a basic input color, and optionally a specular color. The specularity color is the color that shines under intense light.

For example, consider the mini-map to the right. The base color, a dark blue, is connected from an RGB color generator node to the Color input socket. The specular color, yellow, is connected to the Spec input. Under Normal lighting conditions on a flat surface, this material will produce a deep blue color and, as you approach a spot perpendicular to the light, you will see the yellow specular color mix in.

Enable Spec

To see specularity, you have to enable it by clicking the blue Spec button located just below the material color swatch in the node.

Value Node



The Value node has no inputs; it just outputs a numerical value (floating point spanning 0.00 to 1.00) currently entered in the NumButton displayed in its controls selection.

Use this node to supply a constant, fixed value to other nodes' value or factor input sockets.

RGB Node

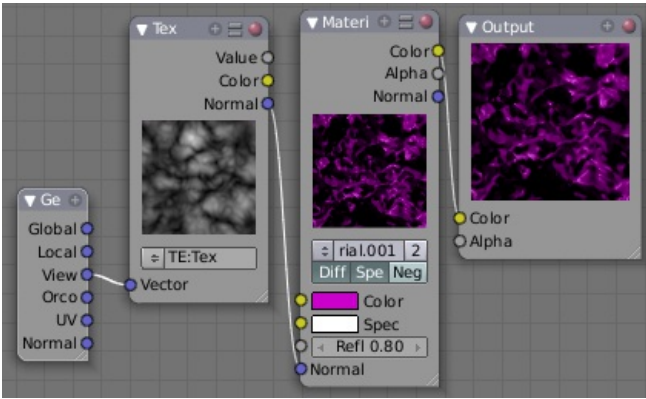


The RGB node has no inputs. It just outputs the Color currently selected in its controls section; a sample of it is shown in the top box. In the example to the right, a gray color with a tinge of red is selected.

To change the brightness and saturation of the color, LMB click anywhere within the square gradient. The current saturation is shown as a little circle within the gradient. To change the color itself, click anywhere along the rainbow Color Ramp.

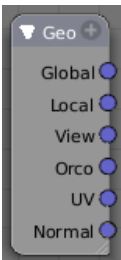
Texture Node

A texture, from the list of textures available in the current blend file, is selected and introduced through the value and/or color socket.



In the example to the right, a cloud texture, as it would appear to a viewer, is added to a base purple material, giving a velvet effect. Note that you can have multiple texture input nodes. In the (old) panel way, multiple textures were assigned to channels and each channel was checked on or off to be applied to the material. With nodes, you simply add the textures to the map and plug them into the map.

Geometry Node



Geometry node

The geometry node is used to specify how light reflects off the surface. This node is used to change a material's Normal response to lighting conditions.

Use this node to feed the Normal vector input on the Material node, to see how the material will look (i.e. shine, or reflect light) under different lighting conditions. Your choices are:

- Global
 - Global position of the surface.
- Local
 - Local position of the surface.
- View
 - Viewed position of the surface.
- Orco
 - Using the Original Coordinates of the mesh.

UV

Using the UV coordinates of the mesh.

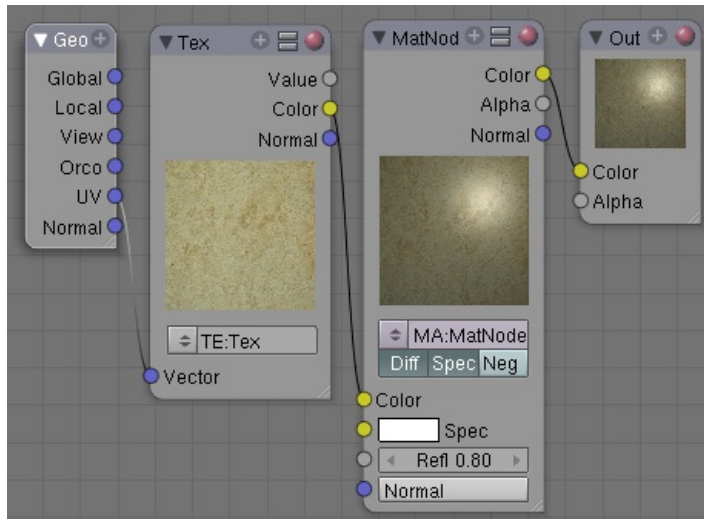
Normal

Surface Normal; On a flat plane with one light above and to the right reflecting off the surface.

Note

These are exactly the same settings as in the [Mapping](#) panel for [Textures](#), though a few settings - like Stress or Tangent - are missing here. Normally you would use this node as input for a [Texture Node](#).

Geometry Node Example using a UV image



Setup to render an UV-Mapped Image Texture.

E.g.: To render an UV-mapped image, you would use the UV output and plug it into the Vector Input of a texture node. Then you plug the color output of the texture node into the color input of the material node - which corresponds to the setting on the Map To panel.

Extended Material

Adds additional input and output channels to the material node.

Input

Color

Includes a color swatch, allowing you to select the color directly on the node.

Mirror Color

?

Ambient

?

Emit

?

SpecTra

?

Ray Mirror

?

Alpha

?

Translucency

?

Output

Diffuse

?

Spec

?

AO

?

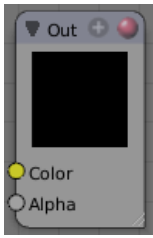
Camera Data

View Vector
?

View Z Depth
?

View Distance
?

Material Output Node



Output node

At any point, you may want to see the work in progress, especially right after some operation by a node. Simply create another thread from the output socket of the node to the picture input socket of an Output node to see a mini-picture.

Connect the alpha channel to set/see transparency.

Effective Output Node

The only Output node that is used for the Material in the end (i.e the only non-Preview) has a little **red sphere** on the upper right.

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Material Color Nodes

Mix

This node mixes a base color or image (threaded to the top socket) together with a second color or image (bottom socket) by working on the individual and corresponding pixels in the two images or surfaces. The way the output image is produced is selected in the drop-down menu. The size (output resolution) of the image produced by the mix node is the size of the base image. The alpha and Z channels (for compositing nodes) are mixed as well.

Not one, not two, but count 'em, sixteen mixing choices include:

Mix	The background pixel is covered by the foreground using alpha values.
Add	The pixels are added together. Fac controls how much of the second socket to add in. Gives a bright result. The "opposite" to Subtract mode.
Subtract	The foreground pixel (bottom socket) is subtracted from the background one. Gives a dark result. The "opposite" to Add mode.
Multiply	Returns a darker result than either pixel in most cases (except one of them equals white=1.0). Completely white layers do not change the background at all. Completely black layers give a black result. The "opposite" to Screen mode.
Screen	Both pixel values are inverted, multiplied by each other, the result is inverted again. This returns a brighter result than both input pixels in most cases (except one of them equals 0.0). Completely black layers do not change the background at all (and vice versa) - completely white layers give a white result. The "opposite" of Multiply mode.
Overlay	A combination of Screen and Multiply mode, depending on the base color.
Divide	The background pixel (top socket) is divided by the second one: if this one is white (= 1.0), the first one isn't changed; the darker the second one, the brighter is the result (division by 0.5 - median gray - is same as multiplication by 2.0); if the second is black (= 0.0, zero-division is impossible!), Blender doesn't modify the background pixel.
Difference	Both pixels are subtracted from one another, the absolute value is taken. So the result shows the distance between both parameters, black stands for equal colors, white for opposite colors (one is black, the other white). The result looks a bit strange in many cases. This mode can be used to invert parts of the base image, and to compare two images (results in black if they are equal).
Darken	Both pixels are compared to each other, the smaller one is taken. Completely white layers do not change the background at all, and completely black layers give a black result.
Lighten	Both parameters are compared to each other, the larger one is taken. Completely black layers do not change the image at all and white layers give a white result.
Dodge	Some kind of inverted Multiply mode (the multiplication is replaced by a division of the "inverse"). Results in lighter areas of the image.
Burn	Some kind of inverted Screen mode (the multiplication is replaced by a division of the "inverse"). Results in darker images, since the image is burned onto the paper, er..image (showing my age).
Color	Adds a color to a pixel, tinting the overall whole with the color. Use this to increase the tint of an image.
Value	The RGB values of both pixels are converted to HSV values. The values of both pixels are blended, and the hue and saturation of the base image is combined with the blended value and converted back to RGB.
Saturation	The RGB values of both pixels are converted to HSV values. The saturation of both pixels are blended, and the hue and value of the base image is combined with the blended saturation and converted back to RGB.
Hue	The RGB values of both pixels are converted to HSV values. The hue of both pixels are blended, and the value and saturation of the base image is combined with the blended hue and converted back to RGB.

Color Channels

There are two ways to express the channels that are combined to result in a color: RGB or HSV. RGB stands for the Red,Green,Blue pixel format, and HSV stands for Hue,Saturation,Value pixel format.

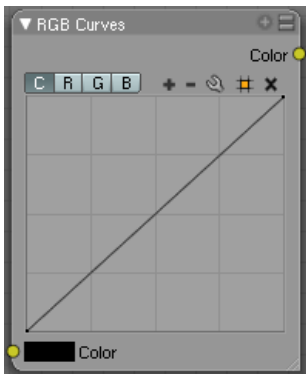
A

Click the green Alpha button to make the mix node use the Alpha (transparency) values of the second (bottom) node. If enabled, the resulting image will have an Alpha channel that reflects both images' channels. Otherwise, (when not enabled, light green) the output image will have the Alpha channel of the base (top input socket) image.

Fac

The amount of mixing of the bottom socket is selected by the Factor input field (Fac:). A factor of zero does not use the bottom socket, whereas a value of 1.0 makes full use. In Mix mode, 50:50 (0.50) is an even mix between the two, but in Add mode, 0.50 means that only half of the second socket's influence will be applied.

RGB Curves

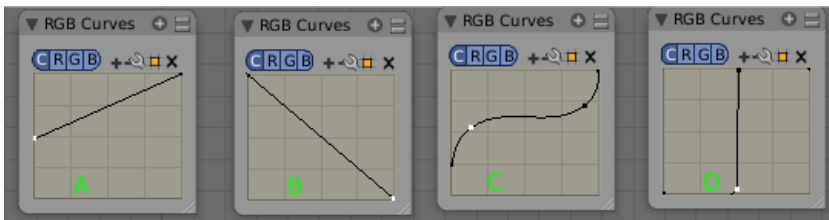


RGB Curves node

For each color component channel (RGB) or the composite (C), this node allows you to define a bezier curve that varies the input (across the bottom, or x-axis) to produce an output value (the y-axis). By default, it is a straight line with a constant slope, so that .5 along the x-axis results in a .5 y-axis output. Click and drag along the curve to create a control point and to change the curve's shape. Use the X to delete the selected (white) point.

Clicking on each C R G B component displays the curve for that channel. For example, making the composite curve flatter (by clicking and dragging the left-hand point of the curve up) means that a little amount of color will result in a lot more color (a higher Y value). Effectively, this bolsters the faint details while reducing overall contrast. You can also set a curve just for the red, and for example, set the curve so that a little red does not show at all, but a lot of red does.

Here are some common curves you can use to achieve desired effects:



A) Lighten B) Negative C) Decrease Contrast D) Posterize

Invert

This node simply inverts the input values and colors.

Hue Saturation Value

Use this node to adjust the Hue, Saturation, and Value of an input.

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Proposed fixes: none

Material Vector Nodes

Normal Node

The Normal node generates a normal vector and a dot product. Click and Drag on the sphere to set the direction of the normal.

This node can be used to input a new normal vector into the mix. For example, use this node as an input to a Color Mix node. Use an Image input as the other input to the Mixer. The resulting colored output can be easily varied by moving the light source (click and dragging the sphere).

The (face) normal is the direction of the face in relation to the camera. You can use it to do the following:

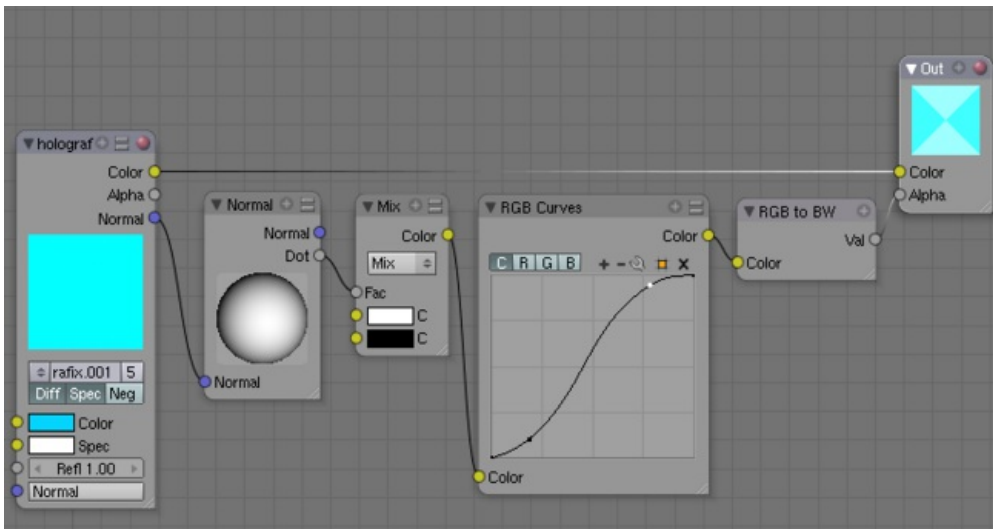
- Use this node to create a fixed direction -> output Normal.
- Calculate the Dot-Product with the Normal-Input. The Dot-Product is a scalar value (a number).
 - If two normals are pointing in the same direction the Dot-Product is 1.
 - If they are perpendicular the Dot-Product is zero (0).
 - If they are antiparallel (facing directly away from each other) the Dot-Product is -1. *And you never thought you would use the Vector Calculus class you took in college - shame on you!*

So now we can do all sorts of things that depends on the viewing angle (like electron scanning microscope effect or some of techniques described in the section [Doc:Tutorials/Textures/Map_Input_Techniques](#)). And the best thing about it is that you can manipulate the direction interactively.

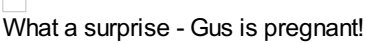
One caveat

The normal is evaluated per face, not per pixel. So you need enough faces, or else you don't get a smooth result

Normal Node Example

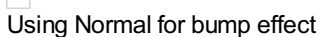


Using the *Dot-Product* for viewing angle dependent material, in this case the *Alpha-Value*.



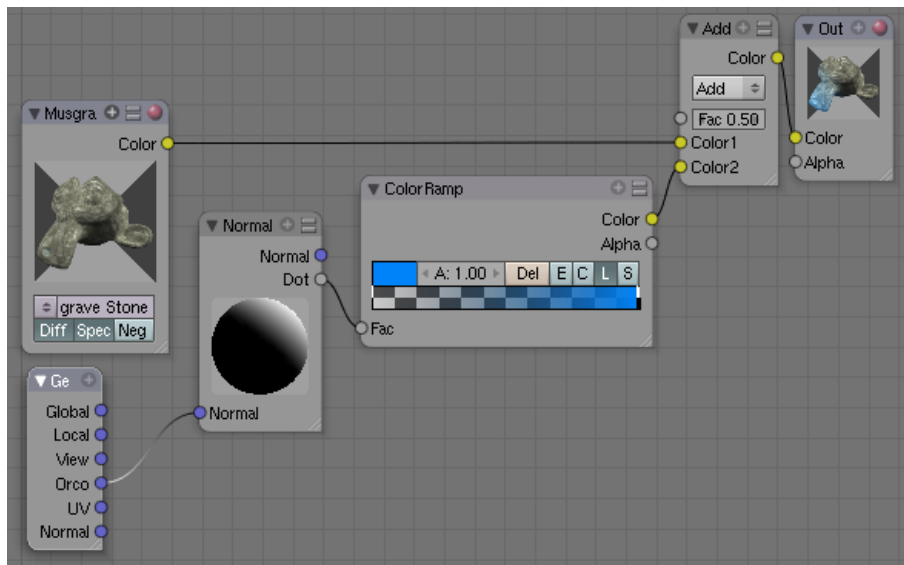
The material is an ordinary blue/cyan material with a high Emit value and Z-Transp activated; the background is black. So, as the face angle gets closer to pointing directly at the camera, the material gets more transparent. As the face gets closer to pointing at a right angle to the camera (in this case facing up or down), it gets more opaque.

We can use the Normal node to shift the reflection, and thus the shininess, of a material as shown below. This effect can also be done without nodes, using the materials and texture panels. However, using Nodes allows you to graphically see what is going on to create the final material. The result is that, even though the surface mesh in your model is physically smooth, the reflection makes it look like it has a very fine bumpiness or uneven coating to it, like a really bad paint job or surface prep job was done. This is key to making realistic-looking surfaces.

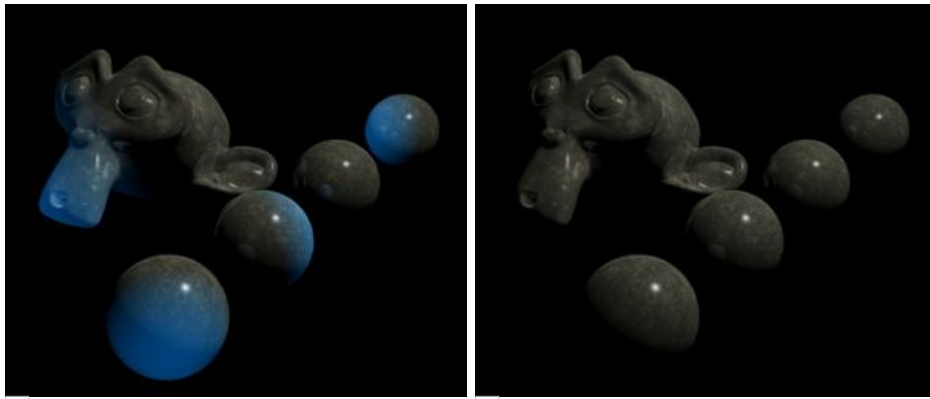


A second material, MatNode, which is the default gray color with a noise texture, is routed through our handy Normal node. The ball has been rolled up and to the right. That puts out a mask that you can see in the Output viewer that is showing the Dot product output. [Mixing](#) that mask with the marbleized color and noise material/texture creates the final output for Material.001. As an exercise for the reader, giving the MatNode a color (instead of the grey) would create a specular effect.

Using the Normal Node to create special Light-Sources



Using the Normal node as a special kind of lightsource.



With the "Light" from the Normal node.

Without the "Light" from the Normal node.

An obvious usage for the Normal node is to use it as a very special lightsource. In (*Using the Normal node as a special kind of lightsource*) the Orco coordinates are used, so the blue light rotates with the object rotation. If we would have used the Normal coordinates, we would have created a kind of object specific backlight. Global coordinates would give a more ordinary, stationary lamp.

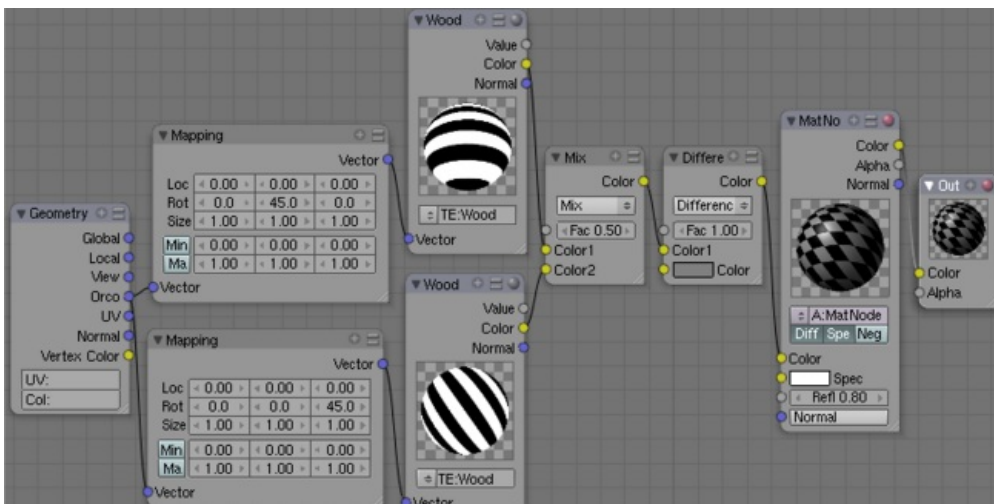
The Fac value in the Mix node (the one with the caption "Add") determines the amount of added color.

Mapping Node

Essentially mapping node allows the user to modify a mapping. It is possible to use it do same operations as the Map Input panel found in Material buttons allows. It also makes it possible to do several things that are not possible in Map Input. Mapping can be rotated and clamped if desired. Currently mapping node supports only flat mapping type though.

The controls of the node have been ordered in X, Y, Z order. If you want to use the clamping options, try enabling Min and Max.

Mapping Node Example





Using mapping nodes to produce amazing chess checkers texture.

This simple example shows one possible way to use mapping nodes to produce interesting textures. As you can see simply by mapping same texture a bit differently can make it useful. Using the same technique it would be easy to mimic different kind of stripy fabrics.

Vector Curves

Use this node to remap a vector value using curve controls.

Page status ([reviewing guidelines](#))

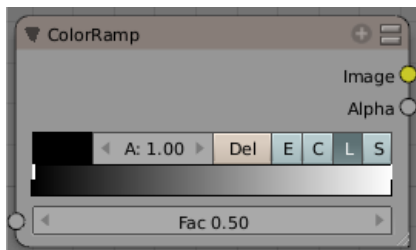
Copy This page is a copy of the same page in 2.4 manual, need to be updated **Partial page**

Proposed fixes: none


Material Convertor Nodes

As the name implies, these nodes convert the colors in the material in some way.


ColorRamp Node



The ColorRamp Node is used for mapping values to colors with the use of a gradient. It works exactly the same way as a [Colorband for textures and materials](#), using the Factor value as a slider or index to the color ramp shown, and outputting a color value and an alpha value from the output sockets.

By default, the ColorRamp is added to the node map with two colors at opposite ends of the spectrum. A completely black black is on the left (Black as shown in the swatch with an Alpha value of 1.00) and a whitewash white is on the right. To select a color, LMB  click on the thin vertical line/band within the colorband. The example picture shows the black color selected, as it is highlighted white. The settings for the color are shown above the colorband as (left to right): color swatch, Alpha setting, and interpolation type.

To change the hue of the selected color in the colorband, LMB  click on the swatch, and use the popup color picker control to select a new color. Press  Enter to set that color.

To add colors, hold Ctrl down and LMB  click inside the gradient. Edit colors by clicking on the rectangular color swatch, which pops up a color-editing dialog. Drag the gray slider to edit Alpha values. Note that you can use textures for masks (or to simulate the old "Emit" functionality) by connecting the alpha output to the factor input of an RGB mixer.

To delete a color from the colorband, select it and press the Delete button.

When using multiple colors, you can control how they transition from one to another through an interpolation mixer. Use the interpolation buttons to control how the colors should band together: Ease, Cardinal, Linear, or Spline.

Use the A: button to define the Alpha value of the selected color for each color in the range.

RGB to BW Node



This node converts a color image to black-and-white.

Connecting Output Socket

When you connect the output Val socket to an input socket that excepts an Image, Blender automatically inserts a ColorRamp node, to translate the output value to a material color.

Math

Vector Math

Squeeze Value

Separate RGB

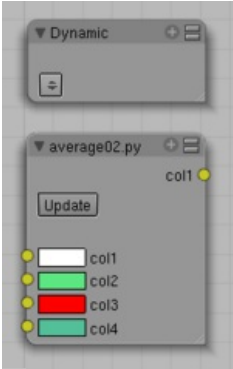
Combine RGB

Page status ([reviewing guidelines](#))

Partial page Text Obsolete

Proposed fixes: none

Materials Dynamic Nodes (PyNodes)



PyNodes. Above one is in default state. One below has a script loaded into it.

Dynamic nodes allow you to write your own custom nodes. These nodes are written in Python. See [API](#) for more specific information.

To use a PyNode load the script of wanted node in Blender's text editor. After this you need to add Dynamic node to your node setup. The node added will contain a file selector. Use it to select the file loaded in text editor. After you have loaded it, it setups the node. If the code is valid, the node will be ready to use. If not, please check Blender's console to see what is wrong.

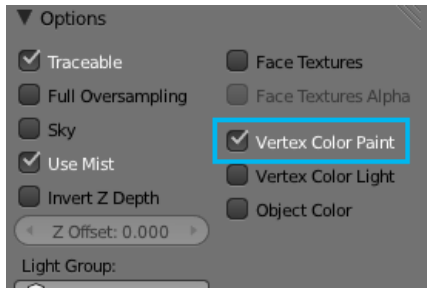
Note that if you make any changes to the script you need to press the Update button seen on the Dynamic node.

You can find PyNode recipes at the [cookbook](#).

Vertex Painting

Vertex Painting is a simple way of painting color onto an object, by directly manipulating the color of vertices, rather than textures, and is fairly straightforward.

Vertex colors can be painted by switching to Vertex Paint Mode, however, it will not show up in the render unless you check "Vertex Color Paint in the Materials Panel.



Settings

The Tools Shelf, shortcut T contains most of the options for vertex painting.

Brush

The image at the top allows you to select tool presets, rename brushes, as well as add custom brushes, and delete them.

Radius

Set the radius of the brush

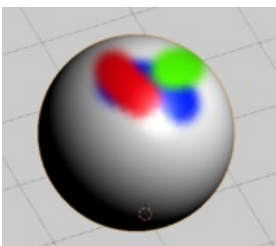
Strength

Set the strength of the brush's effect.

Tool

Mix

Mixes RGB values. When set to a strength of 1.0, it will cover the underlying "paint".



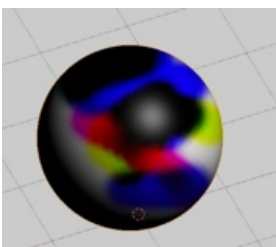
Mix overlay with full strength

Add

Adds RGB values. Will eventually turn the entire object white as RGB values accumulate to 1.0-1.0-1.0: Pure White.

Subtract

Subtracts RGB values. Usually results in Black.



Subtract with full strength

Multiply

Multiplies brush colors by the vertex colors.

Blur

Blurs vertex colors.

Lighten

Lightens the color of the vertices.

Darken

Darkens the color of the vertices.

Stroke

Airbrush

Flow of the brush continues as long as the mouse click is held, determined by the Rate setting. If disabled, the brush only modifies the color when the brush changes its location.

Smooth stroke

Brush lags behind mouse and follows a smoother path. When enabled, the following become active:

Radius

Sets the minimum distance from the last point before stroke continues.

Factor

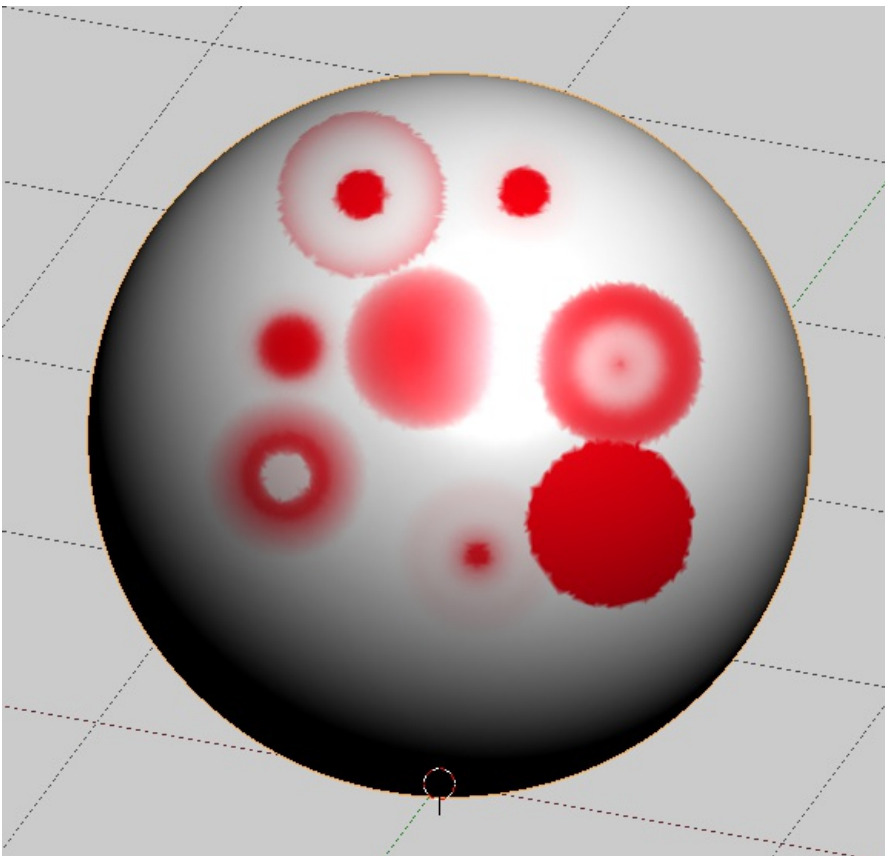
Sets the amount of smoothing.

Space

Creates brush stroke as a series of dots, whose spacing is determined by the Spacing setting. Spacing represents the percentage of the brush diameter.

Curves

Brush Curves affect how strongly the color is applied depending on distance from the center of the brush. In other words, they allow you to edit the Falloff of the brush intensity.



Appearance

Allows you to customize the color of the brush radius outline, as well as specify a custom icon.

Options

All Faces

Paints all faces inside the Brush radius. With it off, only the face that's at the center of the brush will be colored.

Normals

Applies the Vertex Normal before painting. This does not usually affect painting.

Spray

Has bug! Continues painting for as long as the mouse is held.

Unified Settings

Size

All brushes use the same size.

Strength

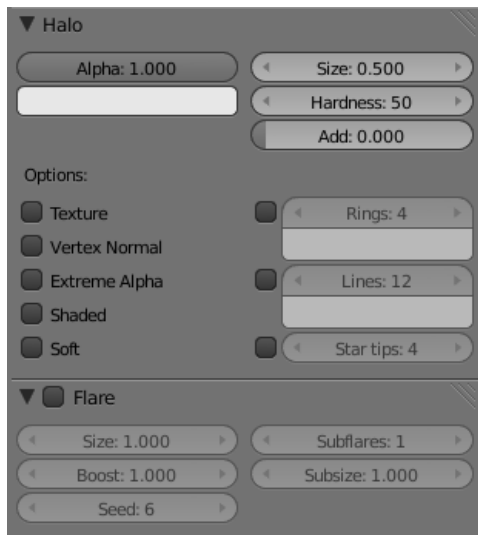
All brushes use the same strength.

Halo Materials

Blender provides a set of materials which do not obey the face-shader paradigm and which are applied on a per-vertex rather than on a per-face basis. These are called Halos because you can see them, but they do not have any substance. They are like little clouds of light; although they are not really lights because they do not cast light into the scene like a lamp.

Halos come in very handy when creating certain special effects, when making an object glow, or when creating a viewable light or fog/atmospherics around an actual light.

Options



Halo panels

To enable Halos, press the Halo button in the Material menu's top panel.

As you will see in the 3D View, the mesh faces are no longer rendered. Instead just the vertex is rendered, since that is where each halo will originate. Halos can be hard to find in a crowded scene, so name it well for easy location in [the outliner](#).

In the properties window, where we normally find the Diffuse, Specular, and Shading panels, we now see panels relative to the Halo characteristics:

Halo Panel

Alpha

The transparency

Color Swatch

The color of the halo itself

Size

Sets the dimension of the halo

Hardness

Sets the hardness of the halo. Similar to specular hardness



Effect of Add

Add

The Add slider determine how much the halo colors are 'added to', rather than mixed with, the colors of the objects behind and together with other halos. By increasing Add, the Halo will appear to light up objects that move behind it or through the Halo field.

Texture

Gives halo a texture. By default, textures are applied to objects with Object coordinates and reflects on the halos by affecting their color, as a whole, on the basis of the color of the vertex originating the halo. Enable this feature to have the

texture take effect *within* the halo, and hence to have it with varying colors or transparencies; this will map the whole texture to *every* halo. This technique proves very useful when you want to create a realistic rain effect using particle systems, or similar.

Vertex Normal

Use the vertex normal to specify the dimension of the halo

Extreme Alpha

Boosts alpha

Shaded

Lets halo receive light and shadows from external objects

When shaded is enabled, the Halo will be affect by local light; a lamp will make it brighter and affect its diffuse color and intensity.

Soft

Softens the edges of the halos at intersections with other geometry

Effects

Enable some or all of these effects, set the number of points/rings, and set the color of each individually:

Rings

Adds circular rings around to the halo.

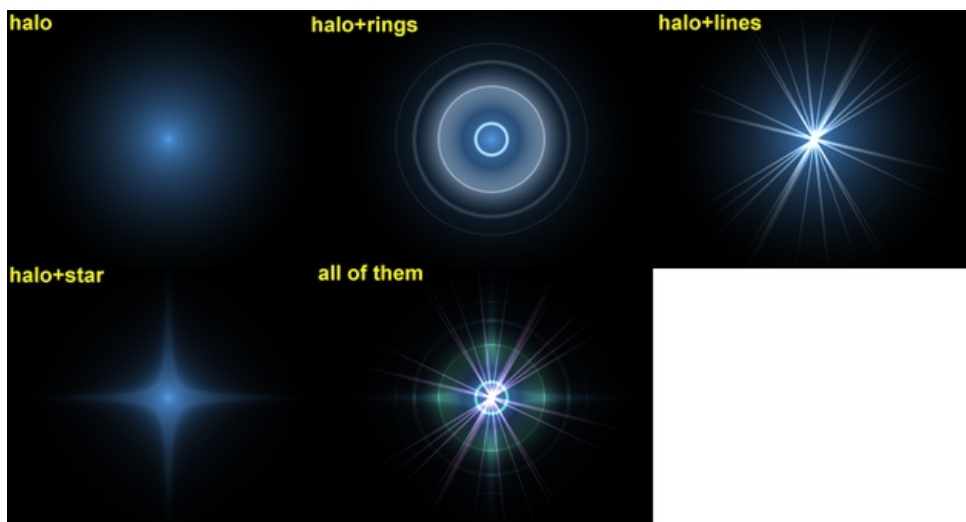
Lines

Adds lines from the center of the halo.

Star tips

Gives the halo a star shape.

You can not use color ramps. Lines, Rings and an assortment of special effects are available with the relevant toggle buttons, which include Flare, Rings, Lines, Star, Texture, Extreme Alpha, and Shaded. *Halo Variations* shows the result of applying a halo material to a single vertex mesh.



Halo Variations

The halo size, hardness and alpha can be adjusted with the pertinent sliders. These are very similar to traditional material settings



The Add slider determine how much the halo colors are 'added to', rather than mixed with, the colors of the objects behind and together with other halos. By increasing Add, the Halo will appear to light up objects that move behind it or through the Halo field.

To set the number of rings, lines, and star points independently, once they are enabled with the relative Toggle Button, use the Num Buttons Rings:, Lines: and Star:. Rings and lines are randomly placed and oriented, to change their pattern you can change the Seed: Num Button which sets the random numbers generator seed.

Flare Panel

Enabling Flare Renders the halo as a lens flare

- Size
 - Sets the factor by which the flare is larger than the halo
- Boost
 - Gives the flare extra strength
- Seed
 - Specifies an offset in the flare seed table
- Subflares
 - Sets the number of subflares
- Subsize
 - Sets the dimensions of the subflares, dots, and circles

Lens Flares

Our eyes have been trained to believe that an image is real if it shows artifacts that result from the mechanical process of photography. *Motion blur*, *Depth of Field*, and *lens flares* are just three examples of these artifacts. The first two are discussed in the *chapter_rendering*; the latter can be produced with special halos. A simulated lens flare tells the viewer that the image was created with a camera, which makes the viewer think that it is authentic.

We create lens flares in Blender from a mesh object using first the Halo button and then the Flare options in the Shaders Panel of the material settings. Try turning on Rings and Lines, but keep the colors for these settings fairly subtle. Play with the Flares: number and Fl.seed: settings until you arrive at something that is pleasing to the eye. You might need to play with Boost: for a stronger effect (*Lens Flare settings*).

Note that this tool does not simulate the physics of photons traveling through a glass lens; it's just a eye candy.

Blender's lens flare looks nice in motion, and disappears when another object occludes the flare mesh.



☐ Lens Flare

Halo Texturing

By default, textures are applied to objects with Object coordinates and reflects on the halos by affecting their color, as a whole, on the basis of the color of the vertex originating the halo. To have the texture take effect *within* the halo, and hence to have it with varying colors or transparencies press the Texture button; this will map the whole texture to *every* halo. This technique proves very useful when you want to create a realistic rain effect using particle systems, or similar.

Another Option is Shaded. When shaded is enabled, the Halo will be affect by local light; a lamp will make it brighter and affect its diffuse color and intensity.

Examples

Dotmatrix display

Let's use a halo material to create a dotmatrix display.

- To begin, add a grid with the dimensions 32x16. Then add a camera and adjust your scene so that you have a nice view of the billboard.
- Use a 2D image program to create some red text on a black background, using a simple and bold font (if you are a lazy lizard [I hope this not offensive, I just like how it sounds!], you can just save the picture below on your hard drive...). *Dot matrix image texture*. shows an image 512 pixels wide by 64 pixels high, with some black space at both sides.



Dot matrix image texture.

- Add a material for the billboard, and set it to the type Halo. Set the HaloSize to 0.06 and when you render the scene you should see a grid of white spots.
- Add a Texture, then change to the Texture Buttons and make it an image texture. When you load your picture and render again you should see some red tinted dots in the grid.
- Return to the Material Buttons and adjust the sizeX parameter to about 0.5 then render again; the text should now be centered on the Billboard.
- To remove the white dots, adjust the material color to a dark red and render. You should now have only red dots, but the billboard is still too dark. To fix this enter EditMode for the board and copy all vertices using the ⇧ ShiftD shortcut (take care not to move them!). Then adjust the brightness with the Add value in the MaterialButtons.



Dot Matrix display.

You can now animate the texture to move over the billboard, using the ofsX value in the Texture panel of the MaterialButtons. (You could use a higher resolution for the grid, but if you do you will have to adjust the size of the halos by shrinking them, or they will overlap. (*Dot Matrix display*)).

Note about material indices

Halo materials only work when applied using the first material index. Any material(s) in a subsequent material index will not be rendered.

Text Empty introductory sections: World Textures, Brush Textures

Proposed fixes: none

Introduction to Textures

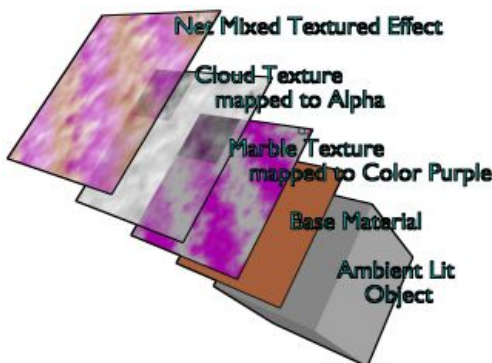
In CGI, texture mapping is a method to add detail to surfaces by projecting images and patterns onto those surfaces. The projected images and patterns can be set to affect not only color, but also specularity, reflection, transparency, and even fake 3-dimensional depth. Most often, the images and patterns are projected during render time, but texture mapping is also used to sculpt, paint and deform objects.

In Blender, Textures can be:

- applied to a *Material*
- applied to the [World Background](#)
- applied to a *Brush*, see for example:
 - [Sculpt Mode](#)
 - [Painting the Texture](#)
- associated with Modifiers, see:
 - Particles textures
 - Ocean textures

Material Textures

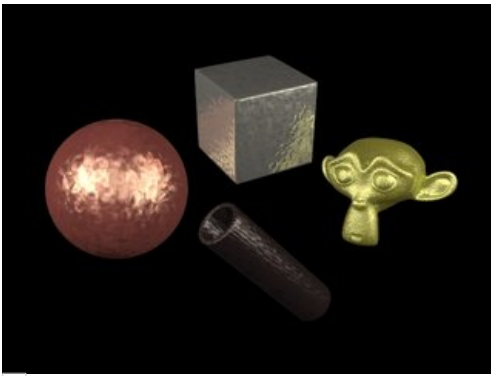
The material settings that we've seen so far produce smooth, *uniform* objects, but such objects aren't particularly true to reality, where uniformity tends to be uncommon and out of place. In order to deal with this unrealistic uniformity, Blender allows the user to apply *textures* which can modify the reflectivity, specularity, roughness and other surface qualities of a material.



Textures Layer on base Material

Textures are like additional layers on top of the base material. Textures affect one or more aspects of the object's net coloring. The net color you see is a sort of layering of effects, shown in this example image. The layers, if you will, are:

1. Your object is lit with **ambient** light based on your world settings.
2. Your base **material** colors the whole surface in a uniform color that reacts to light, giving different shades of the diffuse, specular, and mirror colors based on the way light passes through and into the surface of the object.
3. We have a **primary texture** layer that overlays a purple marble coloring.
4. We next have a **second cloud texture** that makes the surface transparent in a misty/foggy sort of way by affecting the Alpha value
5. These two textures are **mixed** with the base material to provide the net effect; a cube of purplish-brown fog.



Some Metal Textures

This notion of using *more than one* texture, to achieve a combined effect, is one of the "hidden secrets" of creating realistic-looking objects. If you carefully "look at the light" while examining any real-life object, you will observe that the final appearance of that object is best described as the combination, in different ways and in different amounts, of several distinct underlying visual characteristics. These characteristics might be more (or less) strongly apparent at different angles, under different lighting conditions, and so forth. Blender allows you to achieve this in many ways. You can use "a stack of texture layers" as described in [this section](#), or you can also use arbitrarily-complex networks ("noodles"...) of "texture nodes" as discussed [here](#), the choice is yours.

Materials Textures fall into three primary categories:

Procedural Textures

Textures generated by a mathematical formula. For example, Wood, Clouds, and Distorted Noise

Images or Movies

Photos and films projected onto objects. For example, a flat map of Earth mapped to a sphere.

Environment Maps

Textures used to create the impression of reflections and refractions. For example, an image of a street reflected in car window.

Data or Modifiers Textures

Textures obtained from raw data or obtained by a certain modifier in the scene.

For example:

- volumetric materials use Voxel Data textures, or Point Density textures
- textures can be obtained from an Ocean Modifier

note for editors

below we need to add more introductory text for all types of textures

World Textures

Todo

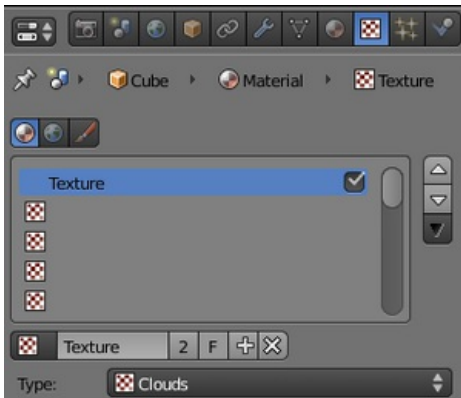
Brush Textures

Todo

Assigning a Texture

This page just shows how to add a texture to a slot. The textures commons options are explained [here](#).

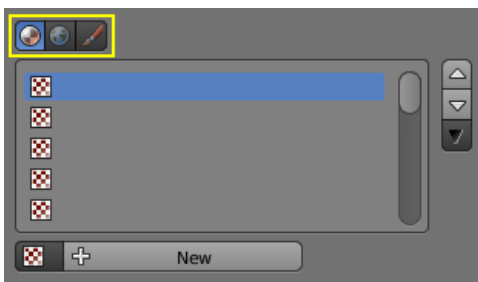
Choosing the Texture context



Texture panel

In the Properties editor, choose the Texture context: this will show the Texture panel.

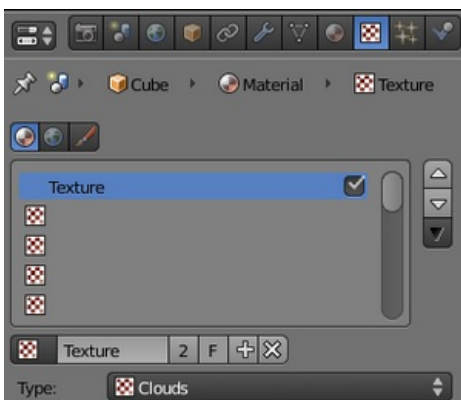
Choosing the Texture data type



Texture panel with buttons for Material, World, and Brush textures highlighted

The three buttons Material, World, Brush at the top of the texture panel indicate the texture data type, that is the kind of texture that is being edited.

Textures Slots




Texture panel

The list below these buttons represent the Stack of textures that we can manage. It can have up to eighteen Texture Slots:

- Tick or untick a texture to enable/disable it.
- Use the three buttons on the right side to move individual textures up and down in the stack or to copy paste material's settings between slots.

Creating a new Texture Datablock in a new Texture Slot

Select an empty slot, then click on the  button.

This will do two things:

- it will create a new texture datablock
- also, it will add a new slot in the textures stack


Creating a new Texture Datablock in a non-empty slot

Select a non empty slot, then click on the  button.

This will do two things:

- it will create a new texture datablock, with a new name, **making a copy of the texture datablock assigned to the selected slot**
- it will assign this new datablock to the selected slot

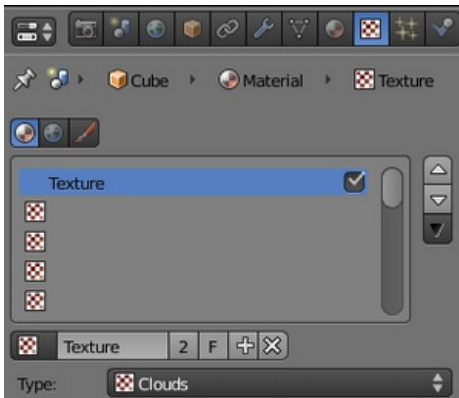
Sharing a Texture Datablock in a non-empty slot

- Select a non empty slot, then click on the  button. This will open a menu showing all the available Textures Datablocks in this file.
- Choose a texture datablock in the menu to assign it to the selected slot. This will share the chosen texture with more than one object, hence the *Number of users* shown in the texture datablock will increase by one.

Textures common options

In the Properties editor, choose the Texture context: this will show the Texture panel.

Textures Stack



Texture panel

The list below these buttons represent the Stack of textures that we can manage. It can have up to eighteen Texture Slots:

- Tick or untick a texture to enable/disable it.
- Use the three buttons on the right side to move individual textures up and down in the stack or to copy paste material's settings between slots.

Texture Datablock

Select a slot in the Textures Stack to see its settings.

The first group of buttons below the stack displays the texture currently selected in the stack.

Browse

The first button below the stack displays the texture all available textures in the current file. Textures are stored globally, and can be linked to more than one material. If you have already created a texture that you want to reuse, select from this list.

Name

A name field where the name of the material can be changed.

Number of users

If the active texture is used by another material, a 2 button appears that can be used to make a single-user copy of the active texture. Use this button to quickly create a new texture based on an existing texture.

Fake

The F button assigns the active texture to a "Fake" material, so that the texture is saved with the file even if it has no "real" users.

Add

Replaces the texture of the active slot with a new texture.

Unlink

Removes the texture from the active slot.

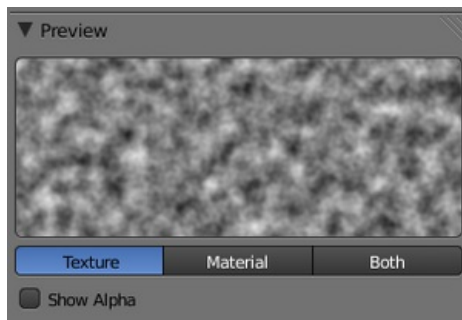
Texture Type

Choose the type of texture that is used for the current texture datablock.

- [Procedural Textures](#)
- [Image](#) and [Video](#) Textures
- [Environment Map](#)
- [Volume Textures](#)
- Ocean Texture

These types are described in the detail [in this section](#).

Preview



Preview panel

The texture preview panel provides a quick pre-visualisation of how the texture looks on its own, without mapping.

Texture, Material, or Both

Choose either to display only the texture, only the material, or both.

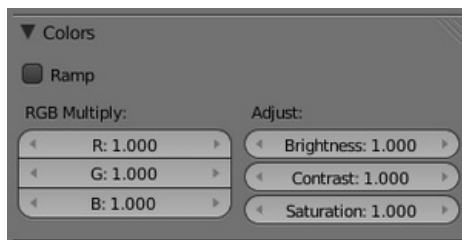
Show Alpha

Show alpha in preview.

If Alpha: Use is checked in the [Image Sampling](#) panel, the image's alpha channel is displayed.

If Alpha: Use is unchecked, an alpha channel based on averaged rgb values is displayed like it would be used by the Alpha slider in the [Influence](#) panel.

Colors



Colors panel

The Ramp button activates a color ramp which allows you to remap the colors of a texture to new ones. See [Ramps](#) for information on using ramps.

The color of a texture can be modified with the Brightness, Contrast, and Saturation buttons. All textures with RGB-Values — including Images and Environment Maps — may be modified with the RGB sliders.

R, G, B

Tint the color of a texture by brightening each red, green and blue channel.

Brightness

Change the overall brightness/intensity of the texture

Contrast

Change the contrast of the texture

Saturation

Change the saturation of the texture

Mapping

Here you can control how the texture will be mapped on the object.

Brushes

This options are not available for brushes because they would't make sense

See [Mapping](#) section for details.

Influence

Here you can control what properties the texture will affect, and how much.

They are detailed on the [Influence](#) section.

Brushes

This options are not available for brushes because they would't make sense

Page status ([reviewing guidelines](#))

Images

old screenshot

There are some old screenshoot. Need to update

Proposed fixes: none

UV Mapping a Mesh

The first step is to unwrap your mesh. You want to unwrap when you feel your mesh is complete with respect to the number of faces it needs to have. If you do add faces or subdivide existing faces when a model is already unwrapped, Blender will add those new faces for you, but you may need to do additional mapping or editing. In this fashion, you can use the UV Texture image to guide additional geometry changes.

This section covers techniques for Mapping Uvs. The next sections cover [Editing UVs](#), followed by methods of [Managing UV Layouts](#), and [Applying Images to UVs](#).

About Uvs

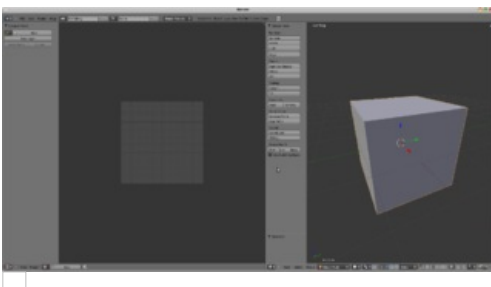
Every point in the UV map corresponds to a vertex in the mesh. The lines joining the UVs correspond to edges in the mesh. Each face in the UV map corresponds to a mesh face.

Each face of a mesh can have many UV Textures. Each UV Texture will have an individual image assigned to it. When you unwrap a face to a UV Texture in the UV/Image Editor, each face of the mesh is automatically assigned *four UV coordinates*: These coordinates define the way an image or a texture is mapped onto the face. These are 2D coordinates, which is why they're called UV, to distinguish them from XYZ coordinates. These coordinates can be used for rendering or for realtime OpenGL display as well.

Every face in Blender can have a link to a different image. The UV coordinates define how this image is mapped onto the face. This image then can be rendered or displayed in realtime. A 3D window has to be in "Face Select" mode to be able to assign Images or change UV coordinates of the active Mesh Object. This allows a face to participate in many UV Textures. A face at the hairline of a character might participate in the facial UV Texture, *and* in the scalp/hair UV Texture.

These are described more fully in the next sections.

Getting Started

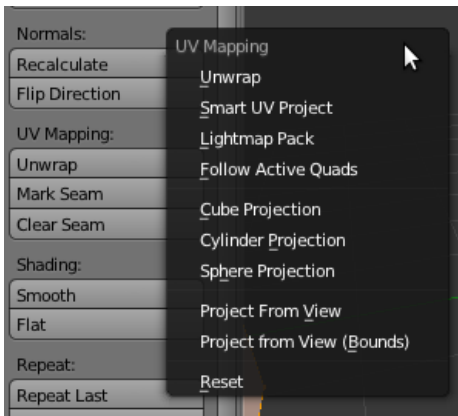


By default, meshes are not created with UVs. First you must map the faces, then you can [edit them](#). The process of unwrapping your model is done within Edit Mode in the 3D View window. This process creates one or more UV Islands in the [UV/Image Editor window](#)

To begin, choose the UV Editing [screen layout](#) from the selection list at the top of your screen in the User Preferences window header. This sets one of the panes to show you the UV/Image Editor window (Shift+f10), and the other pane the 3D window (Shift+f5).

Enter edit mode, as all unwrapping is done in Edit mode. You can be in vertex, face, or edge selection mode.

Workflow



Choosing the unwrapping method

The process for unwrapping is straightforward, but there are tons of options available, each of which dramatically affect the outcome of the unwrap. By understanding the meaning behind the options, you will become more efficient at unwrapping. The process is:

1. Mark Seams if necessary
2. Select all of the mesh components
3. Select a UV mapping method from the UV Unwrap menu
4. Adjust the unwrap settings
5. Add a test image to see if there will be any distortion. See [Applying Images to UVs](#)
6. Adjust UVs in the UV editor. See [Editing UVs](#)

Mapping Types

Blender offers several ways of mapping Uvs. The simpler projection methods use formulas that map 3d space onto 2d space, by interpolating the position of points toward a point/axis/plane through a surface. The more advanced methods can be used with more complex models, and have more specific uses

Basic:

[Cube](#)

Maps the mesh onto the faces of a cube, which is then unfolded.

[Sphere](#)

Projects the Uvs onto a spherical shape. Useful only for spheres or spherical shapes, like eyes, planets, etc.

[Cylinder](#)

Projects Uvs onto a cylindrical surface.

[Project from View](#)

Takes the current view in the 3d viewport and flattens it as it appears

Advanced:

[Unwrap](#)

Useful for organic shapes. Smooths the mesh into a flat surface by cutting along seams.

[Smart UV Project](#)

Breaks the mesh into islands based on an angle threshold

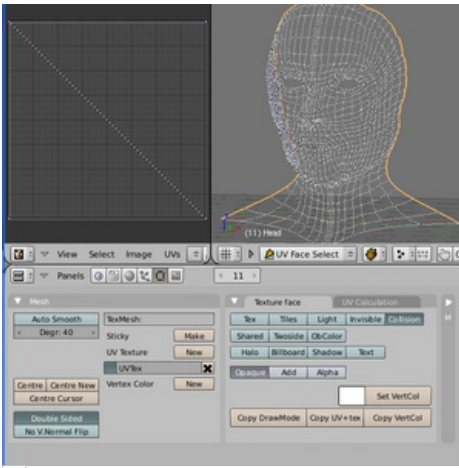
[Lightmap Pack](#)

Separates each face and packs them onto the UV grid

[Follow Active Quads](#)

Follow uv from active quads along continuous face loop

You can also [reset uvs](#), which maps each face to fill the uv grid, giving each face the same mapping.



Selecting Faces in UV Face Select Mode

If we were to use an image that was tileable, the surface would be covered in a smooth repetition of that image, with the image skewed to fit the shape of each individual face. Use this unwrapping option to reset the map and undo any unwrapping (go back to the start).

Basic Mapping

Based on the fundamental geometry of the object, and how it is viewed, the Mesh->UV Unwrap->Cube, Cylinder, and Sphere UV Calculations attempt to unfold the faces for you as an initial best fit. Here, the view from the 3D window is especially important. Also, the settings for cube size or cylinder radius (Editing buttons, UV Calculation panel) should be set (in blender units) to encompass the object.

The following settings are common for the Cube Cylinder and Sphere mappings

Correct Aspect Map Uvs taking image aspect ration into consideration. If an image has already been mapped to the texture space that is non-square, the projection will take this into account and distort the mapping to appear correct. Clip to Bounds Any Uvs that lie outside the 0 to 1 range will be clipped to that range by being moved to the UV space border it is closest to. Scale to Bounds If the UV map is larger than the 0 to 1 range, the entire map will be scaled to fit inside.

Cube

Cube mapping projects s mesh onto six separate planes, creating 6 UV islands. In the UV editor, these will appear overlapped, but can be moved. See [Editing UVs](#).

Cube Size

Set the size of the cube to be projected onto

Cylinder and Sphere

Cylindrical and Spherical mappings have the same settings. The difference is that a cylindrical mapping projects the UVs on a plan toward the cylinder shape, while a spherical map takes into account the sphere's curvature, and each latitude line becomes evenly spaced

Normally, to unwrap a cylinder (tube) as if you slit it lengthwise and folded it flat, Blender wants the view to be vertical, with the tube standing 'up'. Different views will project the tube onto the UV map differently, skewing the image if used. However you can set the axis on which the calculation is done manually. This same idea works for the sphere mapping:

Recall the opening cartographer's approaching to mapping the world? Well, you can achieve the same here when unwrapping a sphere from different perspectives. Normally, to unwrap a sphere, view the sphere with the poles at the top and bottom. After unwrapping, Blender will give you a mercator projection; the point at the equator facing you will be in the middle of the image. A polar view will give a very different but common projection map. Using a Mercator projection map of the earth as the UV image will give a very nice planet mapping onto the sphere.

Direction

View on Poles

Use when viewing from top, at the poles, by using an axis that is straight down from the view

View on Equator

Use if view is looking at the equator, by using a vertical axis

View on Object

Uses the objects transform to calculate the axis

Align

Select which axis is up

Polar ZX

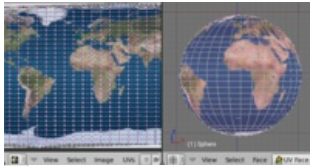
Polar 0 is on the x axis

Polar ZY

Polar 0 is in the y axis

Radius

The radius of the cylinder to use



Using a Mercator image with a Sphere Unwrap

Project From View

In the 3D window, Face->Unwrap UVs->Project from View option maps the face as seen through the view of the 3D window it was selected from. It is almost like you had x-ray vision or squashed the mesh flat as a pancake onto the UV map. Use this option if you are using a picture of a real object as a UV Texture for an object that you have modeled. You will get some stretching in areas where the model recedes away from you.

Using Project from View (Bounds) Will do the same as above, but scale the UVs to the bounds of the UV space.

Resetting UVs

In the 3D window, Face->Unwrap->Reset maps each selected face to the same area of the image, as previously discussed. To map all the faces of an object (a cube for example) to the same image, select all the faces of the cube, and unwrap them using the Reset menu option.

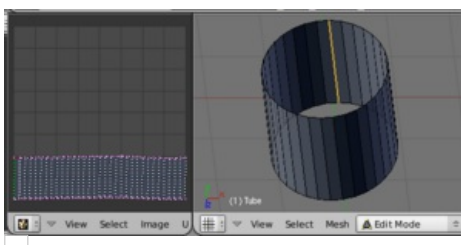
Advanced Mapping

Unwrapping Using Seams

For many cases, using the Unwrap calculations of Cube, Cylinder, Sphere, or best fit will produce a good UV layout. However, for more complex meshes, especially those with lots of indentations, you may want to define a **seam** to limit and guide any of the unwrapping processes discussed above.

Just like in sewing, a seam is where the ends of the image/cloth are sewn together. In unwrapping, the mesh is unwrapped at the seams. Think of this method as peeling an orange or skinning an animal. You make a series of cuts in the skin, then peel it off. You could then flatten it out, applying some amount of stretching. These cuts are the same as seams.

When using this method, you need to be aware of how much stretching there is. The more seams there are, the less stretching there is, but this is often an issue for the texturing process. It's a good idea to have as few seams as possible while having the least amount of stretching. Try to hide seams where they will not be seen. In productions where 3d Paint is used, this becomes less of an issue, as projection painting can easily deal with seams, as opposed to 2d texturing, where it is difficult to match the edges of different UV islands.




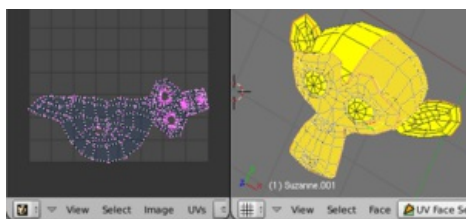
Simple Seam on a Cylinder

The workflow is the following:

1. Create seams. A seam is marked in Edit mode by selecting edges that make the seam and then issuing the command to Mark Seam.
2. Unwrap
3. Adjust seams and repeat
4. Manually adjust Uvs. See the next section on Editing UVs

Marking Seams

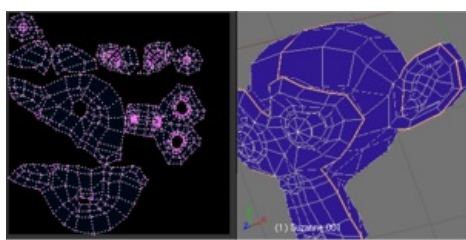
Seams can be marked with Edge selection in Edit Mode. Select the edge(s) that define the seam with border or ⇧ Shift RMB , and press CtrlE or use the Mesh->Edges->Mark Seam menu. In the example to the right, the back-most edge of the cylinder was selected as the seam (to hide the seam), and the default unwrap calculation was used. In the UV/Image Editor window, you can see that all the faces are nicely unwrapped, just as if you cut the seam with a scissors and spread out the fabric.



Oops! Forgot an edge in the seam

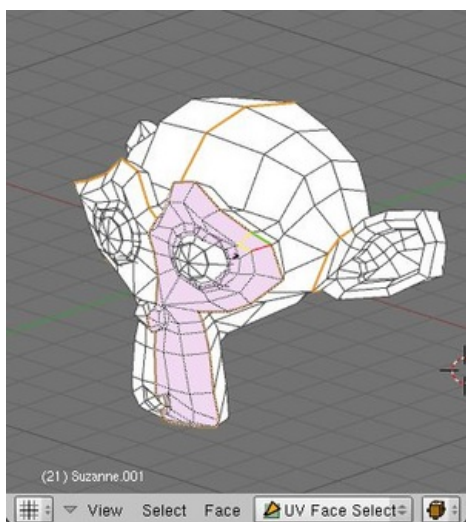
When marking seams, you can use the Select->Linked Faces or CtrlL in Face Select Mode to check your work. This menu option selects all faces connected to the selected one, up to a seam. If faces outside your intended seam are selected, you know that your seam is not continuous. You do not need continuous seams, however. As long as they resolve regions that may stretch

To add an edge to a seam, simply select the edge and CtrlE Mark Seam. To take an edge out of a seam, select it, CtrlE and Clear Seam.



Seamed Suzanne

Just as there are many ways to skin a cat, there are many ways to go about deciding where seams should go. In general though, you should think as if you were holding the object in one hand, and a pair of sharp scissors in the other, and you want to cut it apart and spread it on the table with as little tearing as possible. Note that we seamed the outside edges of her ears, to separate the front from the back. Her eyes are disconnected sub-meshes, so they are automatically unwrapped by themselves. A seam runs along the back of her head vertically, so that each side of her head is flattened out.



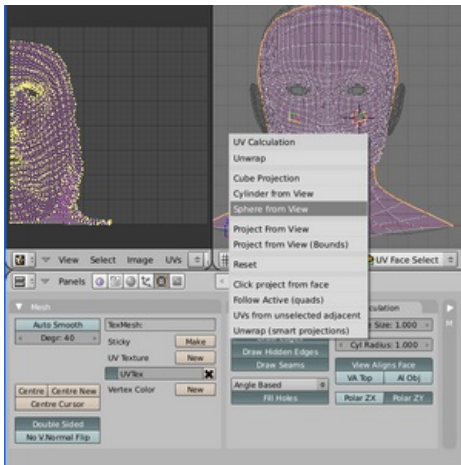
Face Select Mode.

Another use for seams is to limit the faces unwrapped. For example, when texturing a head, you don't really need to texture the scalp on the top and back of the head since it will be covered in hair. So, define a seam at the hairline. Then, when you select a frontal face, and then select linked faces before unwrapping, the select will only go up to the hairline seam, and the scalp will not be unwrapped.

When unwrapping anything that is bilateral, like a head or a body, seam it along the mirror axis. For example, cleave a head or a whole body right down the middle in front view. When you unwrap, you will be able to overlay both halves onto the same texture space, so that the image pixels for the right hand will be shared with the left; the right side of the face will match the left, etc.

Finally, remember that you *don't* have to come up with "one unwrapping that works perfectly for everything everywhere." As we'll discuss later, you can easily have multiple UV unwrappings, using different approaches in different areas of your mesh.

Unwrapping



Unwrapping Faces using 3D View Menu

With our faces selected, it is now time to unwrap them. In the 3D View, select **Face->Unwrap UVs** or **U** and select **Unwrap**.

You can also do this from the UV/Image Editor window with command **UVs->Unwrap** or command **E**. This method will unwrap all of the faces and reset previous work.



Face Unwrap Menu

The **Face->Unwrap->Unwrap** option unwraps the faces of the object to provide the 'best fit' scenario based on how the faces are connected and will fit within the image, and takes into account any seams within the selected faces. If possible, each selected face gets its own different area of the image and is not *tucked under* any other faces. If all faces of an object are selected, then each face is mapped to some portion of the image.

Blender has two ways of calculating the unwrapping. They can be selected in the tool setting in the tool panel in the 3D View.

Angle Based

This method gives a good 2d representation of a mesh.

Conformal

Uses LSCM (Least Squared Conformal Mapping). This usually gives a less accurate UV mapping than Angle Based, but works better for simpler objects.

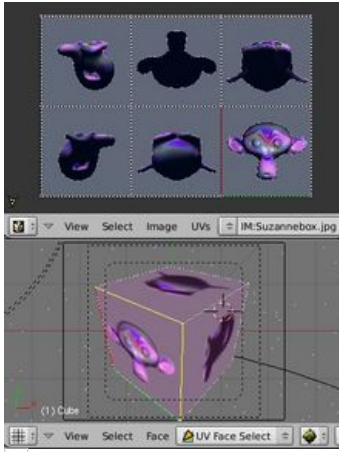
Activating **Fill Holes** will prevent overlapping from occurring and better represent any holes in the UV regions.

This point is crucial to understanding mapping later on: a face's UV image texture only has to use *part* of the image, not the *whole* image. Also, portions of the same image can be shared by multiple faces. A face can be mapped to less and less of the total image.

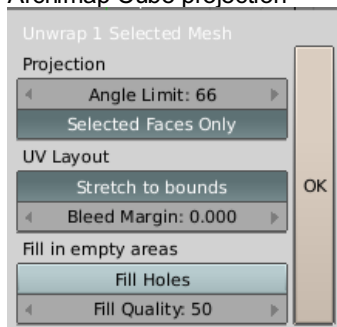
Smart UV Project

Face->Unwrap->Smart UV Project, (which used to be called the Archimapper) gives you fine control over how automatic seams should be created, based on angular changes in your mesh. This method is good for simple and complex geometric forms, such as

mechanical objects or architecture.



Archimap Cube projection



Archimap control panel

This function examines the shape of your object, the faces selected and their relation to one another, and creates a UV map based on this information and settings that you supply.

In the example to the right, the Smart Mapper mapped all of the faces of a cube to a neat arrangement of 3 sides on top, 3 sides on the bottom, for all six sides of the cube to fit squarely, just like the faces of the cube.

For more complex mechanical objects, this tool can very quickly and easily create a very logical and straightforward UV layout for you.

The Tool Settings panel in the Tool Shelf allows the fine control over how the mesh is unwrapped:

Angle Limit

This controls how faces are grouped: a higher limit will lead to many small groups but less distortion, while a lower limit will create less groups at the expense of more distortion.

Island Margin

This controls how closely the UV islands are packed together. A higher number will add more space in between islands.

Lightmap

Lightmap Pack takes each of a meshes faces, or selected faces, and packs them into the UV bounds. Lightmaps are used primarily in gaming contexts, where lighting information is baked onto texture maps, when its is essential to utilize as much UV space as possible. It can also work on several meshes at once. It has several options that appear in the Tool Shelf:

You can set the tool to map just Selected Faces or All Faces if working with a single mesh.

The Selected Mesh Object option works on multiple meshes. To use this, in Object Mode Select several mesh objects, then go into Edit Mode and activate the tool.

Share Tex Space

This is useful if mapping more than one mesh. It Attempts to fit all of the objects' faces in the UV bounds, but not overlapping.

New UV Layer

If mapping multiple meshes, this option creates a new UV layer for each mesh. See [Managing the Layout](#).

New Image

Assigns new images for every mesh, but only one if Shared Tex Space is enabled.

Image Size

Set the size if the new image.

Pack Quality

Pre-packing before the more complex Box packing.

Margin

This controls how closely the UV islands are packed together. A higher number will add more space in between islands.

Follow Active Quads

The Face->Unwrap->Follow Active Quads takes the selected faces and lays them out by following continuous face loops, even if the mesh face is irregularly shaped. Note that it does not respect the image size, so you may have to scale them all down a bit to fit the image area.

Edge Length Mode:

Even

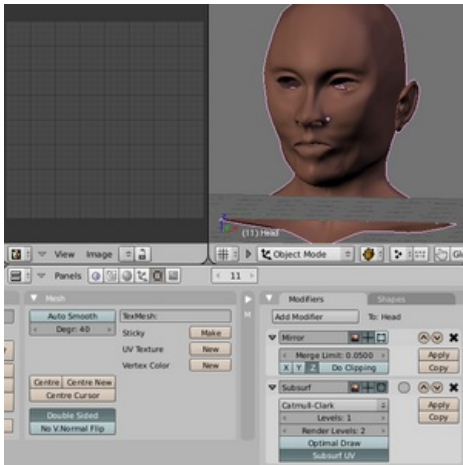
Space all UVs evenly.

Length

Average space UV's edge length of each loop.

Please note that it is the shape of the active quad in UV space that is being followed, not its shape in 3d space. To get a clean 90-degree unwrap make sure the active quad is a rectangle in UV space before using "Follow active quad".

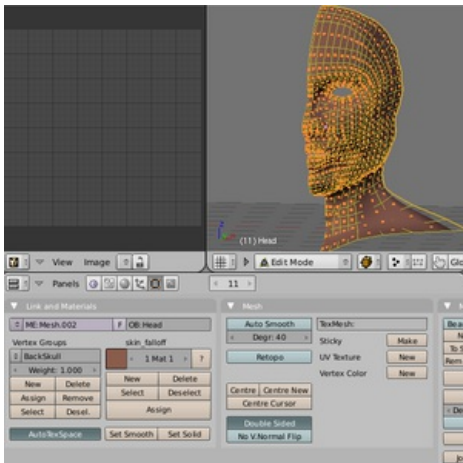
Unwrapping Multiple Faces




Starting Off in Object Mode

In general, you should only unwrap the faces you need to, and do so in a single unwrap operation. You only need to unwrap faces that will be painted using an image; all other faces can use procedural materials and textures or vertex paint. You want to keep your image as small as possible, so that means you want to keep the number of faces as small as possible. For example, if the body is always going to be covered in clothes or armor, there is no need to unwrap it, or they can be mapped separately.

If the back of the head is always going to be covered by hair, there is no need to unwrap the scalp. If you are modeling a chair with an embroidered seat cushion, you only need to unwrap the cushion and not the chair legs. In the example to the right, we only need to unwrap one side of the face, cutting our image size in half, so we leave mirror modifier on; we also do not need to double the number of UV coordinates by applying the Subsurf modifier; we can just leave it as is. Note that at this point, there is no UV Texture in the Mesh panel.



Selecting Faces in Edit Mode

To unwrap multiple faces to a single UV Texture, in Edit Mode ( Tab), enter Face Select mode and select the faces you want.

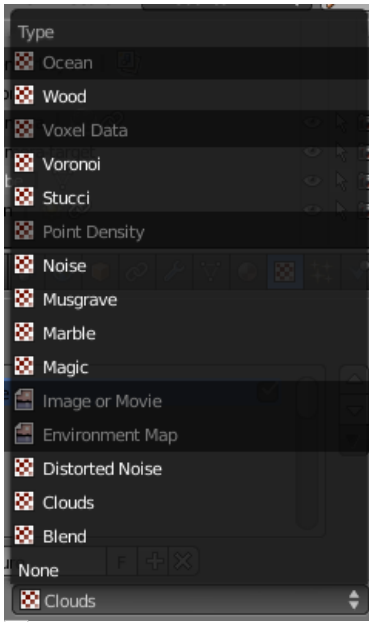
The example to the right shows that we have hidden many faces from view; the ears and the back of the head. We did so by creating and using the Vertex Groups, selecting the "BackSkull" group and Hiding them from view. We did this because we do not want to unwrap those areas, and we don't want them to get in the way during any further face selection that we may do.

Texture types

This are the available texture types:

- [Procedural Textures](#)
- [Image Textures](#)
- [Video Textures](#)
- [Nodes Textures](#)
- [Volume Textures](#)
- [Ocean Textures](#)

Procedural Textures



The Texture Type list in the Texture panel of the Texture Buttons. (Non procedural textures darkened out.)

Procedural textures are textures that are defined mathematically. They are generally relatively simple to use, because they don't need to be mapped in a special way - which doesn't mean that procedural textures can't become very complex.

These types of textures are 'real' 3D. By that we mean that they fit together perfectly at the edges and continue to look like what they are meant to look like even when they are cut; as if a block of wood had really been cut in two. Procedural textures are not filtered or anti-aliased. This is hardly ever a problem: the user can easily keep the specified frequencies within acceptable limits.

These are the available types:

- [Blend](#)
- [Clouds](#)
- [Distorted Noise](#)
- [Magic](#)
- [Marble](#)
- [Musgrave](#)
- [Noise](#)
- [Stucci](#)
- [Voronoi](#)
- [Wood](#)

Common options

Noise Basis

Each noise-based Blender texture (with the exception of Voronoi and simple noise) has a Noise Basis setting that allows the user to select which algorithm is used to generate the texture. This list includes the original Blender noise algorithm. The Noise Basis settings makes the procedural textures extremely flexible (especially Musgrave). There are two more possible settings for Noise Basis, which are relatively similar to Blender Original: Improved Perlin and Original Perlin

The Noise Basis governs the structural appearance of the texture :

☐ Blender Original

☐ Voronoi F1

☐ Voronoi F2-F1

☐ Original Perlin

☐ Voronoi F2

☐ Voronoi Crackle

☐ Improved Perlin

☐ Voronoi F3

☐ Cell Noise

☐ Voronoi F4

Nabla

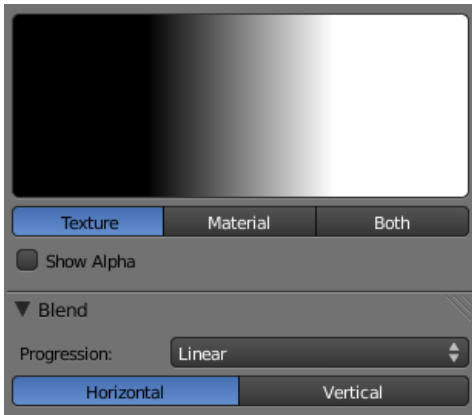
Almost all procedural textures in Blender use derivatives for calculating normals for texture mapping (with as exception Blend and Magic). This is important for Normal and Displacement Maps. The strength of the effect is controlled with the Nabla Number Button.

Hints

Use the size buttons in the Mapping panel to set the size that the procedural textures are mapped to.

Procedural textures can either produce colored textures, intensity only textures, textures with alpha values and normal textures. If intensity only ones are used the result is a black and white texture, which can be greatly enhanced by the use of ramps. If on the other hand you use ramps and need an intensity value, you have to switch on No RGB in the Mapping panel.

Procedural textures: Blend



Blend Texture Panels

Often used for

This is one of the most frequently used procedural textures. You can use blend textures to blend other textures together (with Stencil), or to create nice effects (especially with the Mapping: Normal trick). Just remember: if you use a ramp to create a custom blending, you may have to use No RGB, if the Mapping value needs an intensity input.

Result(s)

Intensity. The Blend texture generates a smoothly interpolated progression.

Options

Progression

Profile of blend

Linear

A linear progression

Quadratic

A quadratic progression

Easing

A flowing, non-linear progression

Diagonal

A diagonal progression

Spherical

A progression with the shape of a three-dimensional ball

Quadratic Sphere

A quadratic progression with the shape of a three-dimensional ball

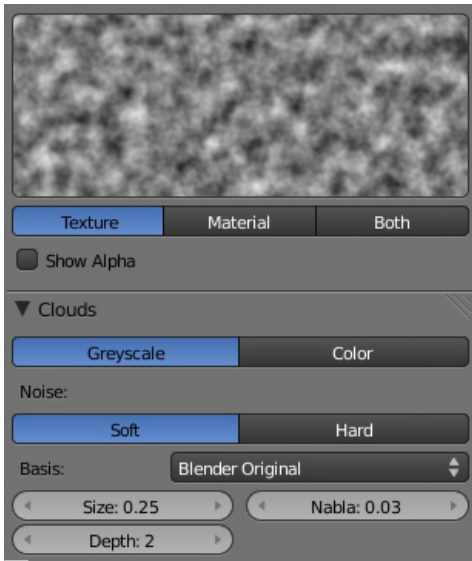
Radial

A radial progression

Horizontal/Vertical

The direction of the progression is flipped a quarter turn.

Procedural textures: Clouds



Clouds Texture Panels

Often used for

Clouds, Fire, Smoke. Well suited to be used as Bump map, giving an overall irregularity to the material.

Result(s)

Greyscale (default) or RGB Color

Options

Greyscale

The standard noise, gives an intensity

Color

The noise gives an RGB value

Noise

Soft or Hard, changes contrast and sharpness

Size

The dimension of the Noise table

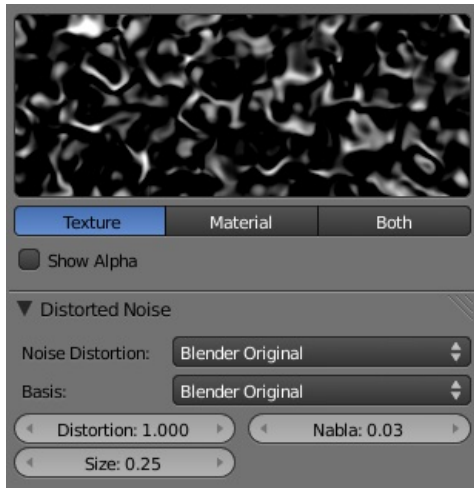
Depth

The depth of the Clouds calculation. A higher number results in a long calculation time, but also in finer details.

Technical Details

A three-dimensional table with pseudo-random values is used, from which a fluent interpolation value can be calculated with each 3D coordinate (thanks to Ken Perlin for his masterful article "An Image Synthesizer", from the SIGGRAPH proceedings 1985). This calculation method is also called Perlin Noise. In addition, each noise-based Blender texture (with the exception of Voronoi and simple noise) has a new "Noise Basis" setting that allows the user to select which algorithm is used to generate the texture.

Procedural textures: Distorted Noise



Distorted Noise Texture Panels

Often used for

Grunge, very complex and versatile

Result(s)

Intensity

Options

Noise Distortion

The texture to use to distort another

Basis

The texture to be distorted

Noise

The size of the noise generated

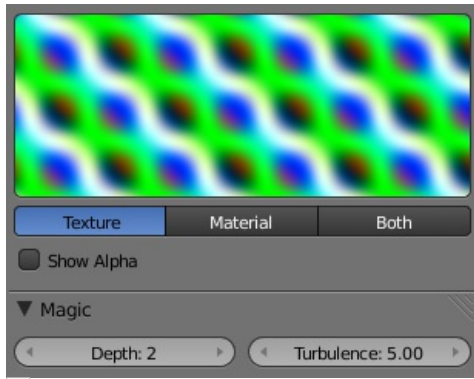
Distortion

The amount that Distortion Noise affects Basis

Technical Details

Distortion Noise takes the option that you pick from Noise Basis and filters it, to create hybrid pattern.

Procedural textures: Magic



Magic Texture Panels

Often used for

Not frequently used. It can be used for "Thin Film Interference", if you set Mapping to Reflection and use a relatively high Turbulence.

Result(s)

RGB color. The RGB components are generated independently with a sine formula.

Options

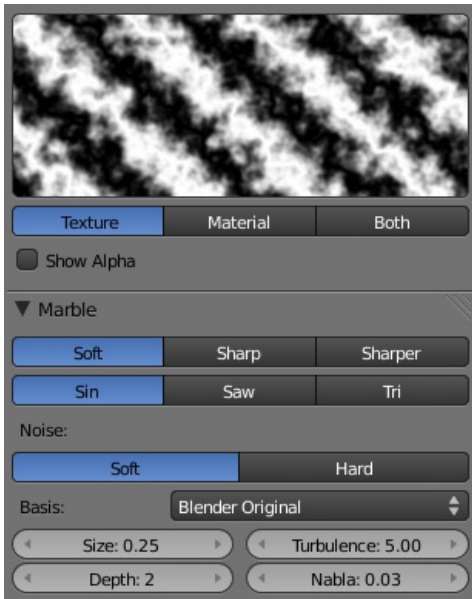
Depth

The depth of the calculation. A higher number results in a long calculation time, but also in finer details.

Turbulence

The strength of the pattern.

Procedural textures: Marble



Marble Texture Panels

Often used for

Marble, Fire, Noise with a structure

Result(s)

Intensity value only

Bands are generated based on either the sine, saw, or triangular formula and noise turbulence.

Options

Soft/Sharp/Sharper

Three presets for soft to more clearly defined Marble

Sin/Saw/Tri

Shape of wave to produce bands

Soft/Hard

The noise function works with two methods.

Size

The dimensions of the noise table

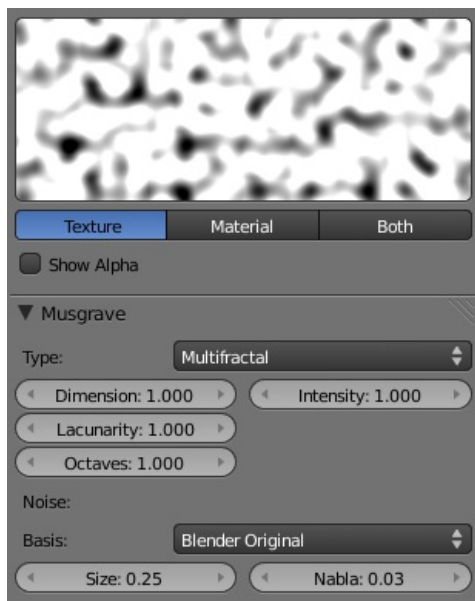
Depth

The depth of the Marble calculation. A higher value results in greater calculation time, but also in finer details.

Turbulence

The turbulence of the sine bands.

Procedural textures: Musgrave



Musgrave Texture Panels

Often used for

Organic materials, but it's very flexible. You can do nearly everything with it.

Result(s)

Intensity

Options

Type

This procedural texture has five noise types on which the resulting pattern can be based and they are selectable from a dropdown menu at the top of the tab. The five types are:

- Hetero Terrain
- fBm
- Hybrid Multifractal
- Ridged Multifractal
- Multifractal

These noise types determine the manner in which Blender layers successive copies of the same pattern on top of each other at varying contrasts and scales.

examples with Basis : Voronoi F1 - Dimension : 0.5 - Lacunarity : 0.15 - Octave: 2.0



The main noise types have four characteristics:

Dimension

Fractal dimension controls the contrast of a layer relative to the previous layer in the texture. The higher the fractal dimension, the higher the contrast between each layer, and thus the more detail shows in the texture. Range: 0 to 2.

Lacunarity

Lacunarity controls the scaling of each layer of the Musgrave texture, meaning that each additional layer will have a scale that is the inverse of the value which shows on the button. i.e. Lacunarity = 2 -> Scale = 1/2 original. Range: 0 to 6.

Octaves

Octave controls the number of times the original noise pattern is overlayed on itself and scaled/contrasted with the fractal dimension and lacunarity settings. Range: 0 to 8.

Intensity

Light intensity. Called Offset for Hetero Terrain. Range: 0 to 10.

The Hybrid Multifractal and Ridged Multifractal types have these additional settings:

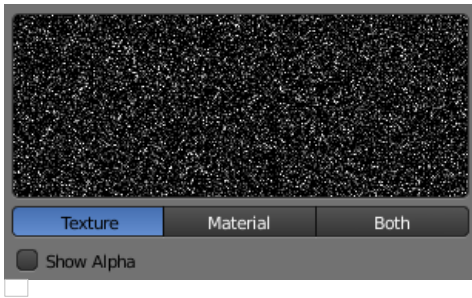
Offset

Both have a "Fractal Offset" button that serves as a "sea level" adjustment and indicates the base height of the resulting bump map. Bump values below this threshold will be returned as zero. Range: 0 to 6.

Gain

Setting which determines the range of values created by the function. The higher the number, the greater the range. This is a fast way to bring out additional details in a texture where extremes are normally clipped off. Range: 0 to 6.

Procedural textures: Noise



Noise Texture Panel

Often used for

White noise in an animation. This is not well suited if you don't want an animation. For material roughness take clouds instead.

Result(s)

Intensity

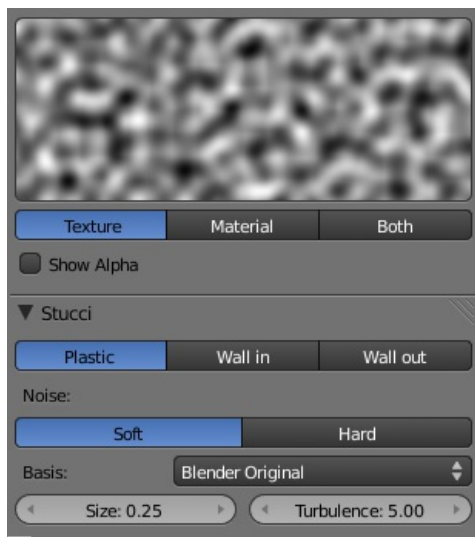
Options

There is no panel and no buttons. Just switch it on.

Technical Details

Although this looks great, it is not Perlin Noise! This is a true, randomly generated Noise. This gives a different result every time, for every frame, for every pixel.

Procedural textures: Stucci



Stucci Texture Panels

The Stucci texture is based on noise functions.

Often used for

Stone, Asphalt, Oranges. Normally for Bump-Mapping to create grainy surfaces.

Result(s)

Normals and Intensity

Options

Plastic/Wall In/Wall out

Plastic is the standard Stucci, whilst the "walls" is where Stucci gets its name. This is a typical wall structure with holes or bumps.

Soft/Hard

There are two methods available for working with Noise

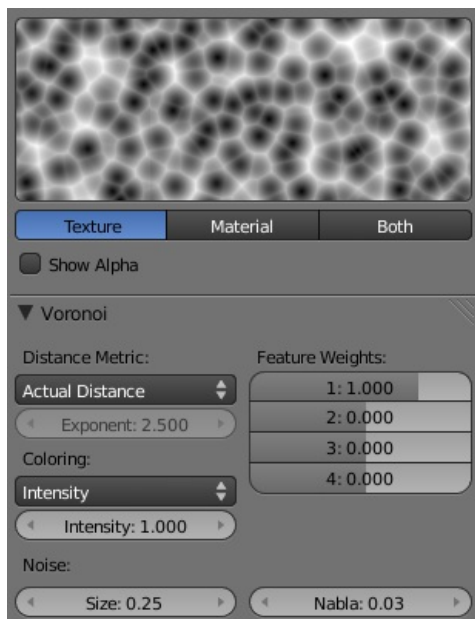
Size

Dimension of the Noise table

Turbulence

Depth of the Stucci calculations

Procedural textures: Voronoi



Voronoi Texture Panels

Often used for

Very convincing Metal, especially the "Hammered" effect. Organic shaders (e.g. scales, veins in skin).

Result(s)

Intensity (default) and Color

Options

Distance Metric

This procedural texture has seven Distance Metric options. These determine the algorithm to find the distance between cells of the texture. These options are:

- Minkovsky
- Minkovsky 4
- Minkovsky 1/2
- Chebychev
- Manhattan
- Distance Squared
- Actual Distance

The Minkovsky setting has a user definable value (the Exponent button) which determines the Minkovsky exponent (e) of the distance function $(x^e + y^e + z^e)^{1/e}$. A value of one produces the Manhattan distance metric, a value less than one produces stars (at **0.5**, it gives a Minkovsky 1/2), and higher values produce square cells (at **4.0**, it gives a Minkovsky 4, at **10.0**, a Chebychev). So nearly all Distance Settings are basically the same - variations of Minkowsky. You can get irregularly-shaped rounded cells with the Actual Distance/Distance Squared options.

☐ Minkovsky Exponent : 0.5
(Minkovsky 1/2)

☐ Minkovsky Exponent : 1
(Manhattan)

☐ Minkovsky Exponent : 2
(Actual Distance)



Minkovsky Exponent : 4
(Minkovsky 4)



Minkovsky Exponent : 10
(Chebychev)



Distance Squared (More
contrast than ActualDistance)

Feature Weights

These four sliders at the bottom of the Voronoi panel represent the values of the four Worley constants, which are used to calculate the distances between each cell in the texture based on the distance metric. Adjusting these values can have some interesting effects on the end result.

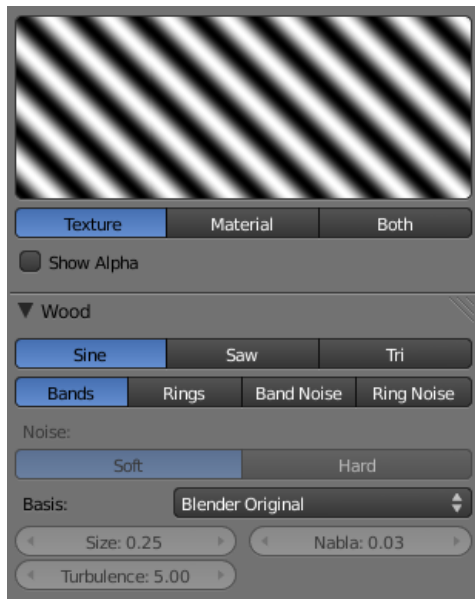
Coloring

Four settings (Intensity, Position, Position and Outline, and Position, Outline, and Intensity) that can use four different noise basis as methods to calculate color and intensity of the texture output. This gives the Voronoi texture you create with the "Worley Sliders" a completely different appearance and is the equivalent of the noise basis setting found on the other textures.

Technical Details

For a more in depth description of the Worley algorithm, see: [Worley Documentation](#)(dead link).

Procedural textures: Wood



Wood Texture Panels

Often used for

Woods and ring-shaped patterns.

Result(s)

Intensity only

Options

Sin/Saw/Tri

Shape of wave to produce bands

Bands/Rings/Band Noise/Ring Noise

Set the bands to either straight or ring-shaped, with or without turbulence

Soft/Hard

There are two methods available for the Noise function

Size

Dimension of the Noise table

Turbulence

Turbulence of the Band Noise and Ring Noise types

Technical Details

Generation

Bands are generated based on a sine formula. You can also add a degree of turbulence with the Noise formula.

Coordinates

As the band is based on a sine formula, the texture repeats itself every π units rather than every 1.0 units. To correct this, scale the texture by a value of π for the dimension you wish.

Page status ([reviewing guidelines](#))

Images

old screenshot

There are some old screenshoot. Need to update

Proposed fixes: none

Image Textures

The term Image Texture simply means that a graphic image — a pixel grid composed of R, G, B, and sometimes Alpha values — is used as the input source to the texture. As with other types of textures, this information can be used in a number of ways, not only as a simple "decal".

When the Texture Type Image or Movie is selected, three new panels present themselves allowing us to control most aspects of how image textures are applied: Image, Image Sampling, and Image Mapping.

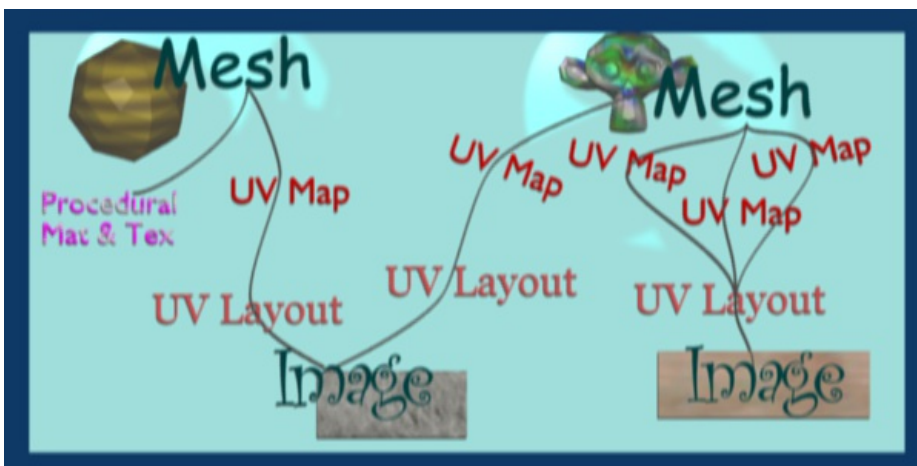
About Image Based Texturing

Texture images take up precious memory space, often being loaded into a special video memory bank that is very fast and very expensive, so it is often very small. So, keep the images as small as possible. A 64x64 image takes up only one fourth the memory of a 128x128 image.

For photo-realistic rendering of objects in animations, often larger image textures are used, because the object might be zoomed in on in camera moves. In general, you want to use a texture sized proportionally to the number of pixels that it will occupy in the final render. Ultimately, you only have a certain amount of physical RAM to hold an image texture and the model and to provide work space when rendering your image.

For the most efficient memory usage, image textures should be square, with dimensions as powers of 2, such as 32x32, 64x64, 128x128, 256x256, 1024x1024, 2048x2048, and 4096x4096.

If you can re-use images across different meshes, this greatly reduces memory requirements. You can re-use images if you map those areas of the meshes that "look alike" to a layout that uses the common image. In the overview below, the left image is re-used for both the sphere and a portion of the monkey. The monkey uses two layouts, one which has one UV map of a few faces, and another that has three maps.



How all the parts of UV Texturing work together

When using file textures, it is very important that you have [Mapped the UVs](#) of the mesh, and they are laid out appropriately.

You don't have to UV map the *entire* mesh. The sphere above on the left has some faces mapped, but other faces use procedural materials and textures. Only use UV Textures for those portions of your mesh where you want very graphic, precise detail. For example, a model of a vase only needs UV Texture for the rim where decorative artwork is incorporated. A throw pillow does not need a different image for the back as the front; in fact many throw pillows have a fabric (procedural material) back.

As another example, you should UV map both eyes of a head to the same image (unless you want one bloodshot and the other clear). Mapping both sides of a face to the same image might not be advisable, because the location of freckles and skin defects are not symmetrical. You could of course change the UV map for one side of the face to slightly offset, but it might be noticeable. Ears are another example where images or section of an images can be mapped to similar faces.

Workflow

The process consists of the following steps.

1. Create the Mesh. [Unwrap](#) it into one or more [UV Layouts](#).
2. Create one or more Materials for the Mesh.
3. Create one or more images for each UV Layout and aspect of the texture. Either
 - paint directly on the mesh using Texture Paint in the 3D window,
 - load and/or edit an image in the UV Editor window, or
 - Bake the existing materials into an image for the UV Editor window.
4. Apply those images as UV Textures to the mesh to affect one or more aspects of the mesh. This is done by using one or more of the numerous Map To options. For example,
 - map to Color to affect the diffuse coloring of the mesh,
 - map to Nor to affect the normal direction to give the surface a bumpy or creased look, or
 - map to Spec (specularity) to make certain areas look shiny and oily.
5. Layer the Textures to create a convincing result.

Using Images and Materials

To use an image as the color and alpha (transparency) of the texture, you can create an image in an external paint program and tell the UV/Image Editor to Open that file as the texture, or you can create a New image and save it as the texture.

If you want to start off by creating an image using an external paint program, you will want to save an outline of your UV faces by using the Save UV Face Layout tool located in the UVs menu. This is discussed [here](#).

Creating an Image Texture

To create an image within Blender, you have to first create a [New Blank](#) Image with a uniform color or test grid. After that, you can color the image using the:

- Vertex colors as the basis for an image
- Render Bake image based on how the mesh looks in the scene

After you have created your image, you can modify it using Blender's built-in [Texture Paint](#) or any external image painting program.

See Texture in 3D View but does not Render

You may be able to see the texture in Textured display mode in the 3D View; this is all that is required to have textures show up in Blender's Game Engine. Rendering, however, requires a material. You must have a Face Textures material assigned to the mesh for it to render using the UV Texture. In the Material settings, ADD NEW material to a selected object and enable Face Textures.

Examples

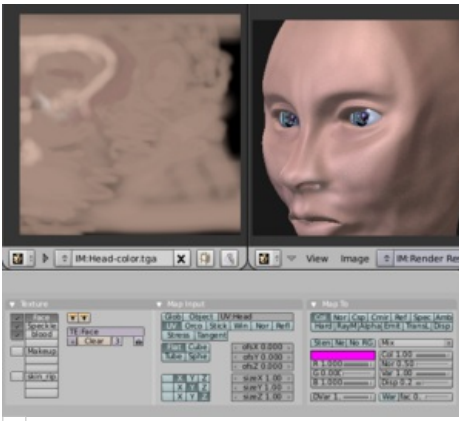
There may be one UV Layout for the face of a character, and another for their clothes. Now, to texture the clothes, you need to create an image at least for the Color of the clothes, and possible a "bump" texture to give the fabric the appearance of some weave by creating a different image for the Normal of the clothes. Where the fabric is worn, for example at the elbows and knees, the sheen, or Specularity, of the fabric will vary and you will want a different image that tells Blender how to vary the Specularity. Where the fabric is folded over or creased, you want another image that maps Displacement to the mesh to physically deform the mesh. Each of these are examples of applying an image as a texture to the mesh.

As another example, the face is the subject of many questions and tutorials. In general, you will want to create a Material that has the basic skin color, appropriate shaders, and sub-surface scattering. Then you will want to layer on additional UV Textures for:

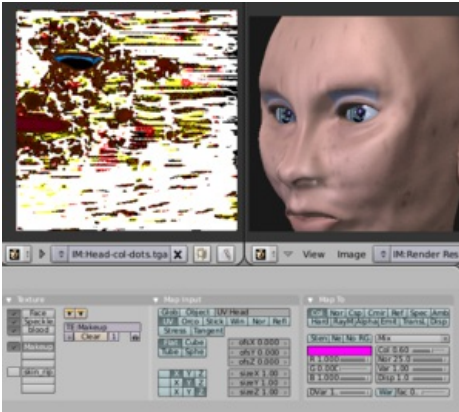
- Freckle map for Color and Normal aspects
- Subdermal veins and tendons for Displacement
- Creases and Wrinkles and skin cell stratification for Normal
- Makeup images for Color
- Oily maps for Specularity
- For a zombie, Alpha transparency where the flesh has rotted away (*ewwww...*)
- Under chin and inside nostrils that receive less Ambient light
- Thin skin is more translucent, so a map is needed for that

Each image is mapped by using another Texture Channel. Each of these maps are images which are applied to the different aspects (Color, Normal, Specularity) of the image. Tileable images can be repeated to give a smaller, denser pattern by using the Texture controls for repeat or size.

Layering UV Textures



Base UV Texture



Layered UV Texture

Great textures are formed by layering images on top of one another. You start with a base layer, which is the base paint. Each successive layer on top of that is somewhat transparent to let the bottom layers show through, but opaque where you want to add on to details.

To avoid massive confusion, all image textures for a mesh usually use the same UV map. If you do, each image will line up with the one below it, and they will layer on top of one another like the examples shown to the right. To do this, just create one UV Texture (map) as described in this section. Then, create material image textures as described in the procedural materials section. Instead of mapping to Original Coordinates (OrCo), map to UV.

Use that map name repeatedly in the Material->Textures->Map Input panel by selecting UV and typing the name in the text field. In the example to the right, our UV Texture is called "Head" (you may have to expand the image to see the panel settings). Then, the image texture shown will be mapped using the UV coordinates. In the "Base UV Texture" example to the right, the face has two textures UV mapped; one for a base color, and another for spots, blemishes and makeup.

Both textures use the same UV Texture map as their Map Input, and both affect Color. The Makeup texture is transparent except where there is color, so that the base color texture shows through. Note that the colors were too strong on the image, so they amount of Col affects is turned down to 60% in the second layer (the blemish layer).

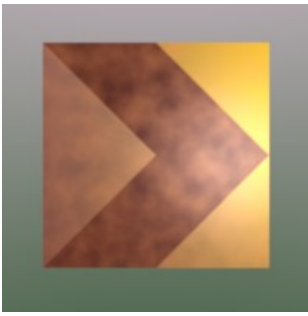
Normally, we think of image textures affecting the color of a mesh. Realism and photo-realistic rendering is a combination of many different ways that light interacts with the surface of the mesh. The image texture can be Mapped To not only color, but also Normal (bumpiness) or Reflection or any of the other attributes specified in the Map To panel.

If you paint a grey-scale image (laid out according to the UV Layout) with white where the skin is oily and shiny, and dark where it is not, you would map that input image according to the UV Layout, but have it affect Specularity (not color).

To make portions of a mesh transparent and thus reveal another mesh surface underneath, you would paint a grey-scale image with black where you want the texture transparent, map input to UV, and map it to Alpha (not color). To make portions of a mesh, like a piece of hot metal, appear to glow, you would use a grey-scale image mapped to Emit.

Believe it or not, this is only "the tip of the iceberg!" If everything that's been described here just isn't enough for you, the *texture nodes* feature, introduced in recent versions of Blender, enables you to layer and combine textures in almost any way you can imagine.

Mix and Match Materials



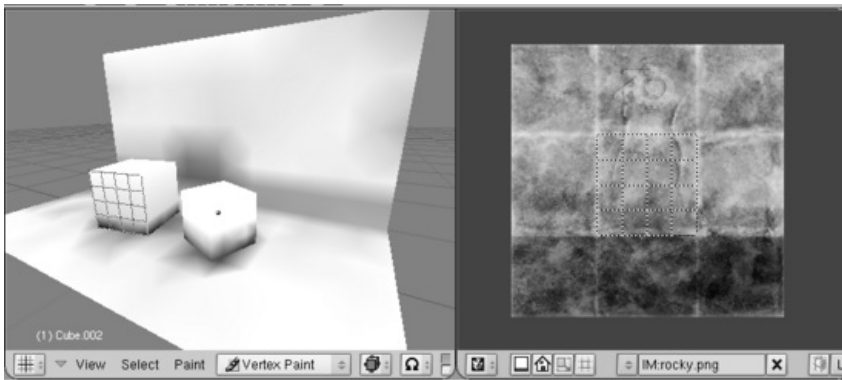
You can mix and match procedural materials and textures, vertex paint, and UV textures onto the same mesh.

The image to the right has a world with a red ambient light. The material has both VCol Paint and Face Textures enabled, and receives half of ambient light. A weak cloud texture affects color, mixing in a tan color. The right vertices are vertex painted yellow and the left is unpainted procedural gray. The UV Texture is a stock arrow image from the public domain texture CD. Scene lighting is a white light off to the right. From this information and the User Manual thus far, you should now be able to recreate this image.

You can also assign [multiple materials](#) to the mesh based on which faces you want to be procedural and which you want to be texture-mapped. Just don't UV map the faces you want to be procedural.

You can use UV Textures and VertexPaint (V in the 3D View window) simultaneously, if both are enabled in the Material settings. The vertex colors are used to modulate the brightness or color of the UV image texture:

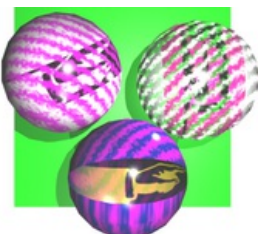
- UV Texture is at the base (*Face Textures*)
- Vertex paint affects its colors, then
- Procedural textures are laid on top of that,
- Area lights shine on the surface, casting shadows and what not, and finally
- Ambient light lights it up.



Vertex colors modulate texture.

A UV Layout can only have one image, although you can tile and animate the image. Since a layout is a bunch of arranged UV Maps, and a UV Map maps many mesh faces, a face can therefore only have one UV Texture image, and the UV coordinates for that face must fit entirely on the image. If you want a face to have multiple images, split the face into parts, and assign each part its own image. (Or you can get fancy with Nodes, but that's another story ...)

Using Alpha Transparency



☐ Alpha UV Textures

Alpha 0.0 (transparent) areas of a UV Image render as black. Unlike a procedural texture, they do not make the base material transparent, since UV Textures do not operate on the base procedural material. The UV texture overrides any procedural color underneath. Procedural Textures are applied on top of UV Textures, so a procedural image texture would override any UV Texture. Transparent (black) areas of a procedural texture mapped to alpha operate on top of anything else, making the object transparent in those places. The only thing that modulates visible parts of a UV Texture are the Vertex Colors. In the example to the right, the finger image is transparent at the cuff and top of the finger and is used as a UV Texture. All three balls have a base material of blue and a marbling texture. The base material color is not used whenever Face Textures is enabled.

The top left ball has not had any vertex painting, and the finger is mapped to the middle band, and the texture is mapped to a pink

color. As you can see, the base material has VCol Paint and Face Textures enabled; the base color blue is not used, but the texture is. With no vertex painting, there is nothing to modulate the UV Texture colors, so the finger shows as white. Transparent areas of the UV Image show as black.

The top right ball has had a pink vertex color applied to the vertical band of faces (in the 3D View window, select the faces in UV Paint mode, switch to Vertex Paint mode, pick a pink color, and Paint->Set Vertex Colors). The finger is mapped to the middle vertical band of faces, and VCol and Face Textures are enabled. The texture is mapped to Alpha black and multiplies the base material alpha value which is 1.0. Thus, white areas of the texture are 1.0, and 1.0 times 1.0 is 1.0 (last time I checked, at least), so that area is opaque and shows. Black areas of the procedural texture, 0.0, multiply the base material to be transparent. As you can see, the unmapped faces (left and right sides of the ball) show the vertex paint (none, which is gray) and the painted ones show pink, and the middle stripe that is both painted and mapped change the white UV Texture areas to pink. Where the procedural texture says to make the object transparent, the green background shows through. Transparent areas of the UV Texture insist on rendering black.

The bottom ball uses multiple materials. Most of the ball (all faces except the middle band) is a base material that does not have Face Textures (nor Vertex Color Paint - VCol Paint) enabled. Without it enabled, the base blue material color shows and the pink color texture is mixed on top. The middle band is assigned a new material (2 Mat 2) that *does* have vertex paint and Face Textures enabled. The middle band of faces were vertex painted yellow, so the white parts of the finger are yellow. Where the pink texture runs over the UV texture, the mixed color changes to green, since pink and yellow make a green.

If you want the two images to show through one another, and mix together, you need to use Alpha. The base material can have an image texture with an Alpha setting, allowing the underlying UV Texture to show through.

To overlay multiple UV images, you have several options:

- Create multiple UV Textures which map the same, and then use different images (with Alpha) and blender will overlay them automatically.
- Use the [Composite Nodes](#) to combine the two images via the AlphaOver node, creating and saving the composite image. Open that composited image as the UV Texture.
- Use an external paint program to alpha overlay the images and save the file, and load it as the face's UV Texture
- Define two objects, one just inside the other. The inner object would have the base image, and the outer image the overlaid image with a material alpha less than one (1.0).
- Use the [Material nodes](#) to combine the two images via the AlphaOver or Mix node, thus creating a third noded material that you use as the material for the face. Using this approach, you will not have to UV map; simply assign the material to the face using the Multiple Materials

UV Textures vs. Procedural Textures

A Material Texture, that has a Map Input of UV, and is an image texture that is mapped to Color, is equivalent to a UV Texture. It provides much more flexibility, because it can be sized and offset, and the degree to which it affects the color of your object can be controlled in the Map To panel. In addition, you can have different images for each texture channel; one for color, one for alpha, one for normals, one for specular, one for reflectivity, *etc.* Procedural textures, like Clouds, are INCREDIBLY simple and useful for adding realism and details to an image.

UV Texture	Procedural Texture
Image maps to precise coordinates on the selected faces of the mesh	Pattern is generated dynamically, and is mapped to the entire mesh (or portion covered by that material)
The Image maps once to a range of mesh faces specifically selected	Maps once to all the faces to which that material is assigned; either the whole mesh or a portion
Image is mapped once to faces.	Size XYZ in the MapInput allows tiling the texture many times across faces. Number of times depends on size of mesh
Affect the color and the alpha of the object.	Can also affect normals (bumpiness), reflectivity, emit, displacement, and a dozen other aspects of the mesh's appearance; can even warp or stencil subsequent textures.
Can have many for a mesh	Can be layered, up to 10 textures can be applied, layering on one another. Many mix methods for mixing multiple channels together.
Any Image type (still, video, rendered). Preset test grid available	Many different presents: clouds, wood grain, marble, noise, and even magic.
Provides the UV layout for animated textures	Noise is the only animated procedural texture
Takes very limited graphics memory	Uses no or little memory; instead uses CPU compute power

So, in a sense, a single UV texture for a mesh is simpler but more limited than using multiple textures (mapped to UV coordinates), because they do one specific thing very well: adding image details to a range of faces of a mesh. They work together if the procedural texture maps to the UV coordinates specified in your layout. As discussed earlier, you can map multiple UV textures to different images using the UV Coordinate mapping system in the Map Input panel.

Settings

Image

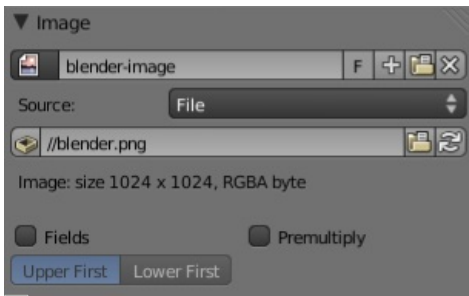


Image panel

In the Image Sampling panel we tell Blender which source file to use.

Image texture

Browse

Select an image among linked to the .blend file

Name field

Internal name of image

F

Create a fake user for the image texture

+

Replace active texture with a new one

Folder

Browse for an image on your computer

X

Unlink this image

Source

What kind of source file to use.

File

Pack image

Embed image into current .blend file

Path

Path to file

File Browser

Find a file on your computer. Hold ⇧ Shift to open the selected file and Ctrl to browse a containing directory.

Reload

Reloads the file. Useful when an image has been rework in an external application.

Fields

Work with field images. Video frames consist of two different images (fields) that are merged. This option ensures that when Fields are rendered, the correct field of the image is used in the correct field of the rendering. MIP Mapping cannot be combined with Fields. Normally, the first field in a fielded (interlaced) video frame begins on the first line (Upper First.) Some frame grabbers do this differently (Lower First.)

Premultiply

Premultiplied alpha is when the RGB values of an image are multiplied by the image's alpha value before compositing.

Sequence/Movie

Frames

Number of frames in the movie or sequence to use

Start

Start frame in sequence/movie

Offset

What frame number inside the movie/sequence to start grabbing

Fields

Number of fields per rendered frame. Used with Fields and interlaced video, it says whether each image has both odd and even, or just one.

Auto Refresh

Automatically refresh images on frame changes

Cyclic

When the video ends, it will loop around the to the start and begin playing again.

Generated

Size

Width and height of image to be generated

Blank/UV Grid/Color Grid

Which kind of image to be generated

Image Sampling

In the Image Sampling panel we can control how the information is retrieved from the image.

The two images presented here are used to demonstrate the different image options. The *background image* is an ordinary JPG-file, the *foreground image* is a PNG-file with various alpha and greyscale values. The vertical bar on the right side of the foreground image is an Alpha blend, the horizontal bar has 50% alpha.



Left: Background image
Right: Foreground image

Alpha

Options related to transparency

Use

Works with PNG and TGA files since they can save transparency information (Foreground Image with UseAlpha). Where the alpha value in the image is less than 1.0, the object will be partially transparent and stuff behind it will show.

Calculate

Calculate an alpha based on the RGB values of the Image. Black (0,0,0) is transparent, white (1,1,1) opaque. Enable this option if the image texture is a mask. Note that mask images can use shades of gray that translate to semi-transparency, like ghosts, flames, and smoke/fog.

Invert

Reverses the alpha value. Use this option if the mask image has white where you want it transparent and vice-versa.



Left: Foreground image with Use alpha. The alpha values of the pixels are evaluated
Right: Foreground image with Calculate alpha

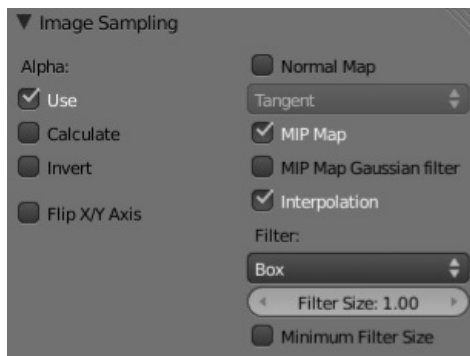


Image Sampling panel

Normal Map

This tells Blender that the image is to be used to create the illusion of a bumpy surface, with each of the three RGB channels controlling how to fake a shadow from a surface irregularity. Needs specially prepared input pictures. See [Bump and Normal Maps](#).

Normal Map Space

Tangent
Object
World
Camera

MIP Map

[MIP Maps](#) are pre-calculated, smaller, filtered Textures for a certain size. A series of pictures is generated, each half the size of the former one. This optimizes the filtering process. By default, this option is enabled and speeds up rendering (especially useful in the game engine). When this option is OFF, you generally get a sharper image, but this can significantly increase calculation time if the filter dimension (see below) becomes large. Without MIP Maps you may get varying pictures from slightly different camera angles, when the Textures become very small. This would be noticeable in an animation.


MIP Map Gaussian filter

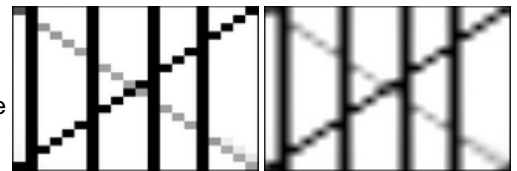
Used in conjunction with MIP Map, it enables the MIP Map to be made smaller based on color similarities. In the game engine, you want your textures, especially your MIP Map textures, to be as small as possible to increase rendering speed and frame rate.

Flip X/Y Axis

Rotates the image 90 degrees counterclockwise when rendered.

Interpolation

This option interpolates the pixels of an image. This becomes visible when you enlarge the picture. By default, this option is on. Turn this option OFF to keep the individual pixels visible and if they are correctly anti-aliased. This last feature is useful for regular patterns, such as lines and tiles; they remain 'sharp' even when enlarged considerably. When you enlarge this 10x10 pixel Image , the difference with and without InterPolation is clearly visible. Turn this image off if you are using digital photos to preserve crispness.



Enlarged Image texture without and with InterPolation

Filter

The filter size used in rendering, and also by the options MipMap and Interpol. If you notice gray lines or outlines around the textured object, particularly where the image is transparent, turn this value down from 1.0 to 0.1 or so.

Texture Filter Type

Texture filter to use for image sampling. Just like a *pixel* represents a *picture element*, a *texel* represents a *texture element*. When a texture (2D texture space) is mapped onto a 3D model (3D model space), different algorithms can be used to compute a value for each pixel based on samplings from several texels.

Box

A fast and simple nearest-neighbor interpolation known as Monte Carlo integration

EWA

Elliptical Weighted Average — one of the most efficient direct convolution algorithms developed by Paul Heckbert and Ned Greene in the 1980s. For each texel, EWA samples, weights, and accumulates texels within an elliptical footprint and then divides the result by the sum of the weights.

FELINE

FELINE (Fast Elliptical Lines), uses several isotropic probes at several points along a line in texture space to produce an anisotropic filter to reduce aliasing artifacts without considerably increasing rendering time.

Probes

Number of probes to use. An integer between 1 and 256.

Area

...

Eccentricity

Maximum Eccentricity. Higher values give less blur at distant/oblique angles, but is slower

Further reading

McCormack, J; Farkas, KI; Perry, R; Jouppi, NP (1999) [Simple and Table Feline: Fast Elliptical Lines for Anisotropic Texture Mapping](#), WRL

Eccentricity

Maximum eccentricity. Higher gives less blur at distant/oblique angles, but is also slower

Filter Size

The filter size used by MIP Map and Interpolation

Minimum Filter Size

Use Filter Size as a minimal filter value in pixels

Image Mapping

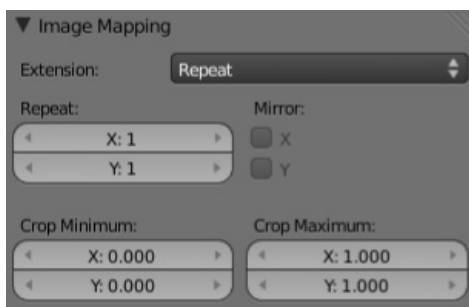


Image Mapping panel

In the Image Mapping panel, we can control how the image is mapped or projected onto the 3D model.

Extension

Extend

Outside the image the colors of the edges are extended

Clip

Clip to image size and set exterior pixels as transparent. Outside the image, an alpha value of 0.0 is returned. This allows you to 'paste' a small logo on a large object.

Clip Cube

Clips to cubic-shaped area around the images and sets exterior pixels as transparent. The same as Clip, but now the 'Z' coordinate is calculated as well. An alpha value of 0.0 is returned outside a cube-shaped area around the image.

Repeat

The image is repeated horizontally and vertically

Repeat

X/Y repetition multiplier

Mirror

Mirror on X/Y axes. This buttons allow you to map the texture as a mirror, or automatic flip of the image, in the corresponding X and/or Y direction.

Checker

Checkerboards quickly made. You can use the option size on the Mapping panel as well to create the desired number of checkers.

Even/Odd

Set even/odd tiles

Distance

Governs the distance between the checkers in parts of the texture size

Crop Minimum/Crop Maximum

The offset and the size of the texture in relation to the texture space. Pixels outside this space are ignored. Use these to crop, or choose a portion of a larger image to use as the texture.

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Partial page

Proposed fixes: none

Video Textures

Video Textures are added in the same way that image textures are. Note- Blender will cut the movie at 100 frames, so you must choose "Match Movie Length".

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Texture Nodes

As an alternative to using the [Texture Stack](#), Blender includes a node-based texture generation system which enables you to create textures by combining colors, patterns and other textures in much the same way that you combine [Material Nodes](#).

You can use these textures wherever you can use regular textures: you can place them in texture channels, in material nodes, in particle systems, and even inside other textures.

Node networks ("noodles") contain three general types of nodes: **input** nodes, **filter** (or **transformation**) nodes, and **output** nodes. You can include any number of these nodes into the network, and connect them in any number of ways. This gives you limitless creative and technical control.

Note

Node-based textures do **not** work for realtime display, they will only be visible in rendered images.

Using Texture Nodes

To use texture nodes with the current texture, open a [Node Editor window](#), set it to Texture mode by clicking the "Texture" icon in its header.

To start adding nodes, you first need to select a material. Now you can either click the New button in the Node editor, or the New button in the texture panel. Once you have a texture selected, you can toggle it to function as a regular texture or a node texture by clicking the Use Nodes option in the Node Editor.

The default node setup will appear: a red-and-white checkerboard node connected to an Output named "Default". For *texture* nodes, you can create as many Outputs as you like in your node setup. (Other types of node networks, as you may recall, are limited to only one Output node.) See the next section for details.

For instructions on how to add, remove and manipulate the nodes in the tree, see the [Node Editor manual](#).

Using Multiple Outputs

Each texture that you define with Texture Nodes can have several outputs, which you can then use for different things. For example, you might want your texture to define both a diffuse (color) map and a normal map. To do this, you would:

1. Create two texture slots in the texture list, and set them to the same texture datablock.
2. Add two Output nodes to the node tree, and type new names into their Name text-boxes: e.g. "Diffuse" for one and "Normal" for the other.
3. Underneath the texture picker in the texture panel, you'll see a dropdown list with the names of your outputs. For each entry in the texture list, select the desired output by changing the menu entry (e.g. set on to "Diffuse" and the other to "Normal").

You can also use these named outputs if you've decided to define your material using Material Nodes. In this case, you probably won't be using Texture Channels. Instead, you'll insert Texture nodes into your Material Node tree using Add → Input → Texture. Then, inside the texture node that you've just added, you can select which output you want to use (e.g. Diffuse or Normal).

See also

- [Development page](#)

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Proposed fixes: none

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Text missing dupli part

Proposed fixes: none

Texture Mapping

Textures need mapping coordinates, to determine how they are applied to the object. The mapping specifies how the texture will ultimately wrap itself to the object.

For example, a 2D image texture could be configured to wrap itself around a cylindrical shaped object.

Coordinates



Mapping Coordinate menu

Coordinates Mapping works by using a set of coordinates to guide the mapping process. These coordinates can come from anywhere, usually the object to which the texture is being applied to.

Global

The scene's global 3D coordinates. This is also useful for animations; if you move the object, the texture moves across it. It can be useful for letting objects appear or disappear at a certain position in space.

Object

Uses an object as source for coordinates. Often used with an Empty, this is an easy way to place a small image at a given point on the object (see the [example below](#)). This object can also be animated, to move a texture around or through a surface.

Object

Select the name of an object.

Generated

The original undeformed coordinates of the object. This is the default option for mapping textures.

UV

UV mapping is a very precise way of mapping a 2D texture to a 3D surface. Each vertex of a mesh has its own UV co-ordinates which can be unwrapped and laid flat like a skin. You can almost think of UV coordinates as a mapping that works on a 2D plane with its own local coordinate system to the plane on which it is operating on. This mapping is especially useful when using 2D images as textures, as seen in [UV Mapping](#). You can use multiple textures with one set of UV coordinates.

Layer

Select your UV layer to use it for mapping.

Strand/Particle

Uses normalized 1D strand texture coordinate or particle age(X) and trail position (Y). Use when texture is applied to hair strands or particles.

Sticky

Uses a mesh's sticky coordinates, which are a form of per-vertex UV co-ordinates. If you have made sticky coordinates first (in (usually) Camera View → Space → type Sticky → choose Add Sticky/Remove Sticky), the texture can be rendered in camera view (so called "[Camera Mapping](#)").

Window

The rendered image window coordinates. This is well suited to blending two objects.

Normal

Uses the direction of the surface's normal vector as coordinates. This is very useful when creating certain special effects that depend on viewing angle.

Reflection

Uses the direction of the reflection vector as coordinates. This is useful for adding reflection maps — you will need this input when Environment Mapping.

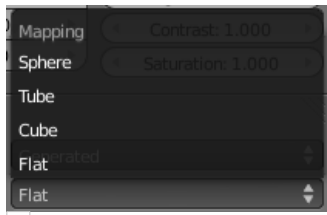
Stress

Uses the difference of edge length compared to original coordinates of the mesh. This is useful, for example, when a mesh is deformed by modifiers.

Tangent

Uses the optional tangent vector as texture coordinates.

Projection



Projection menu

Flat

Flat mapping gives the best results on single planar faces. It does produce interesting effects on the sphere, but compared to a sphere-mapped sphere the result looks flat. On faces that are not in the mapping plane the last pixel of the texture is extended, which produces stripes on the cube and cylinder.

Cube

Cube mapping often gives the most useful results when the objects are not too curvy and organic (notice the seams on the sphere).

Tube

Tube mapping maps the texture around an object like a label on a bottle. The texture is therefore more stretched on the cylinder. This mapping is of course very good for making the label on a bottle or assigning stickers to rounded objects. However, this is not a cylindrical mapping so the ends of the cylinder are undefined.

Sphere

Sphere mapping is the best type for mapping a sphere, and it is perfect for making planets and similar objects. It is often very useful for creating organic objects. It also produces interesting effects on a cylinder.

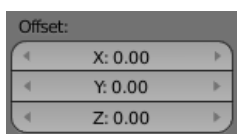
Inheriting coordinates from the parent object

From Dupli

Duplis instanced from vertices, faces, or particles, inherit texture coordinates from their parent.

Todo: explanation

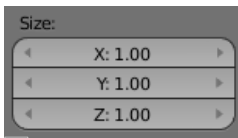
Coordinate Offset, Scaling and Transformation



Offset panel

Offset

The texture co-ordinates can be translated by an offset. Enlarging of the Ofs moves the texture towards the top left.



Size panel

Size

These buttons allow you to change the mapping of axes between the texture's own coordinate system, and the mapping system you choose (Generated, UV, etcetera.) More precisely, to each axis of the texture corresponds one of four choices, that allow you to select to which axis in the mapping system it maps! This implies several points:

- For 2D textures (such as images), only the first two rows are relevant, as they have no Z data.
- You can rotate a 2D picture a quarter turn by setting the first row (i.e. X texture axis) to Y, and the second row (Y texture axis) to X.
- When you map no texture axis (i.e. the three "void" buttons are set), you'll get a solid uniform texture, as you use zero dimension (i.e. a dot, or pixel) of it (and then Blender extends or repeats this point's color along all axes.)
- When you only map one texture axis (i.e. two "void" buttons are enabled), you'll get a "striped" texture, as you only use one dimension (i.e. a line of pixel) of it, and then Blender stretches this line along the two other axes.
- The same goes, for 3D textures (i.e. procedural ones), when one axis is mapped to nothing, Blender extends the plan ("slice") along the relevant third axis.

So, all this is a bit hard to understand and master. Fortunately, you do not have to change these settings often, except for some special effects... Anyway, the only way to get used to them is to practice!

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UV Mapping

The most flexible way of mapping a 2D texture over a 3D object is a process called "UV mapping". In this process, you take your three-dimensional (X,Y & Z) mesh and unwrap it to a flat two-dimensional (X & Y ... or rather, as we shall soon see, "U & V") image. Colors in the image are thus mapped to your mesh, and show up as the color of the faces of the mesh. Use UV texturing to provide realism to your objects that procedural materials and textures cannot do, and better details than Vertex Painting can provide.

UVs Explained



Box being inspected



Box mapped flat

The best analogy to understanding UV mapping is cutting up a cardboard box. The box is a three-dimensional (3D) object, just like the mesh cube you add to your scene.

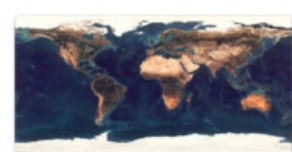
If you were to take a pair of scissors and cut a seam or fold of the box, you would be able to lay it flat on a tabletop. As you are looking down at the box on the table, we could say that U is the left-right direction, is V is the up-down direction. This image is thus in two dimensions (2D). We use **U** and **V** to refer to these "texture-space coordinates" instead of the normal **X** and **Y**, which are always used (along with **Z**) to refer to "3D space."

When the box is reassembled, a certain UV location on the paper is transferred to an (X,Y,Z) location on the box. This is what the computer does with a 2D image in wrapping it around a 3D object.

During the UV unwrapping process, you tell Blender exactly how to map the faces of your object (in this case, a box) to a flat image in the UV/Image Editor window. You have complete freedom in how to do this. (Continuing our previous example, imagine that, having initially laid the box flat on the tabletop, you now cut it into smaller pieces, somehow stretch and/or shrink those pieces, and then arrange them in some way upon a photograph that's also lying on that tabletop ...)

Cartography Example

Cartographers (map makers) have been dealing with this problem for millennia. A cartography (map-making) example is creating a projection map of the whole world. In cartography, we take the surface of the earth (a sphere) and make a flat map that can be folded up into the glove compartment aboard the space shuttle. We 'fill in' spaces toward the poles, or change the outline of the map in any of several ways:



Mercator Projection



Mollweide Projection



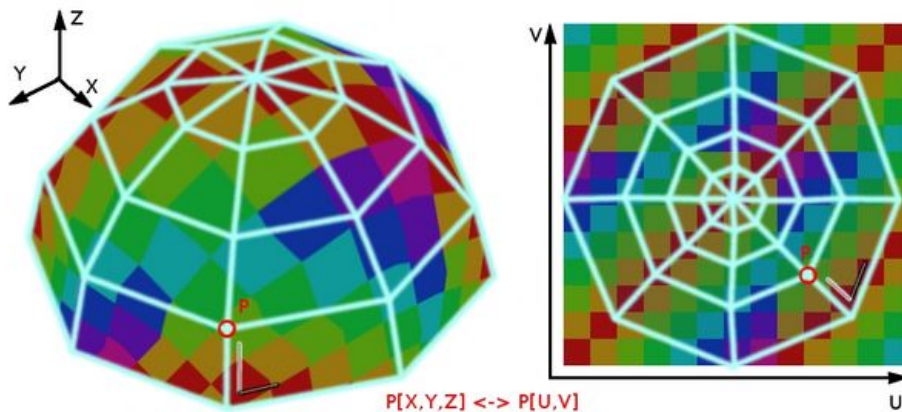
Albers-equal Projection

Each of these is an example of a way to UV map a sphere. Each of the hundred or so commonly accepted projections has its advantages and disadvantages. Blender allows us to do the same thing any way we want to, on the computer.

On more complex models (like seen in the earth map above) there pops up an issue where the faces can't be 'cut', but instead they

are stretched in order to make them flat. This helps making easier UV maps, but sometimes adds distortion to the final mapped texture. (Countries and states that are closer to the North or the South Pole look smaller on a flat map than do ones which are close to the Equator.)

Half-Sphere Example



☐ 3D Space (XYZ) versus UV Space (click to enlarge)

In this image you can easily see that the shape and size of the marked face in 3D space is different in UV space.

This difference is caused by the 'stretching' (technically called mapping) of the 3D part (XYZ) onto a 2D plane (i.e the UV map).

If a 3D object has a UV map, then, in addition to the 3D-coordinates X, Y, and Z, each point on the object will have corresponding U and V coordinates. (P in the image above is an example of how a point on a 3D object might be mapped onto a 2D image.)

The UV Editor

The UV/Image Editor is where you will be editing the UVs. This is an overview of the tools found there. Using the UV editor is explained more in depth in the next sections.

Header Bar

The header bar contains several menus and options for working with UVs

View Menu

Tools for [Navigating](#), working with the editor and controlling how things are displayed. The properties panel has display options and manipulation tools. When an image is being used, image properties are displayed. The Scopes panel is used when working with Images. It contains different image visualizers

Select Menu

Tools for [Selecting UVs](#).

Image Menu

This contains options for when [Working with Images](#) and [Painting Textures](#).

UVs Menu

Contains tools for [Unwrapping Meshes](#) and [Editing UVs](#).

Image Selector Menu

Select the image to apply when [Working with Images](#).

[Pin Image](#)

Displays current image regardless of selected object.

[Pivot Point Selector](#)

Similar to working with Pivot Points in the 3D view.

[Sync Selection](#)

Keeps UV and Mesh component selections in sync.

[Selection Modes](#)

- Vertex
- Edge
- Face
- Island

[Sticky Selection Mode](#)

When Sync Selection is disabled, these options control how UVs are selected.

[Proportional Editing](#)

Works like [Proportional Editing in the 3d view](#)

[UV Snapping](#)

Similar to Snapping in the 3D View

[Active UV Texture Selector](#)

Select which UV texture to use

Properties Panel

Grease Pencil

Similar to [Grease Pencil](#) in the 3d view.

UV Vertex

[Transform Properties](#) for select UVs

Image


Contains the properties of the current [Image](#)

Display

Controls [Display Options for UVs](#), and additional settings for when [Working with Images](#).

Navigating in UV Space

Panning can be done by clicking the MMB  and dragging.

Zooming can be done by scrolling MMB  up or down. Also, as in the 3D view, you can use + NumPad or - NumPad to zoom.

The following shortcuts are available, and through the View Menu:

- Zoom 1:8 8 NumPad
- Zoom 1:4 4 NumPad
- Zoom 1:2 2 NumPad
- Zoom 1:1 1 NumPad
- Zoom 2:1 ⇧ Shift2 NumPad
- Zoom 4:1 ⇧ Shift4 NumPad
- Zoom 8:1 ⇧ Shift8 NumPad
- View All ↵ Home
- View Center . NumPad

Display Options

You can set how UVs are displayed in the Display Panel:

Outline/Dash/Black/White

Sets how UV edges are displayed

Smooth

Makes edges appeared Antialiased

Modified

Show results of modifiers in the UV display

Stretch

Shows how much of a difference there is between UV coordinates and 3D coordinates. Blue means low distortion, while Red means high distortion. Choose to display the distortion of Angles or the Area.

Advantages of UVs

While procedural textures (described in the previous chapters) are useful-they never repeat themselves and always "fit" 3D objects-they are not sufficient for more complex or natural objects. For instance, the skin on a human head will never look quite right when procedurally generated. Wrinkles on a human head, or scratches on a car do not occur in random places, but depend on the shape of the model and its usage. Manually-painted images, or images captured from the real world gives more control and realism. For details such as book covers, tapestry, rugs, stains, and detailed props, artists are able to control every pixel on the surface using a UV Texture.

A UV map describes what part of the texture should be attached to each polygon in the model. Each polygon's vertex gets assigned to 2D coordinates that define which part of the image gets mapped. These 2D coordinates are called UVs (compare this to the XYZ coordinates in 3D). The operation of generating these UV maps is also called "unwrap", since it is as if the mesh were unfolded onto a 2D plane.

For most simple 3D models, Blender has an automatic set of unwrapping algorithms that you can easily apply. For more complex 3D models, regular Cubic, Cylindrical or Spherical mapping, is usually not sufficient. For even and accurate projection, use seams to guide the UV mapping. This can be used to apply textures to arbitrary and complex shapes, like human heads or animals. Often these textures are painted images, created in applications like the Gimp, Photoshop, or your favorite painting application.

Games

UV mapping is also essential in the Blender game engine, or any other game. It is the de facto standard for applying textures to models; almost any model you find in a game is UV mapped.

Page status ([reviewing guidelines](#))

Images

old screenshot

There are some old screenshoot. Need to update

Proposed fixes: none

UV Mapping a Mesh

The first step is to unwrap your mesh. You want to unwrap when you feel your mesh is complete with respect to the number of faces it needs to have. If you do add faces or subdivide existing faces when a model is already unwrapped, Blender will add those new faces for you, but you may need to do additional mapping or editing. In this fashion, you can use the UV Texture image to guide additional geometry changes.

This section covers techniques for Mapping Uvs. The next sections cover [Editing UVs](#), followed by methods of [Managing UV Layouts](#), and [Applying Images to UVs](#).

About Uvs

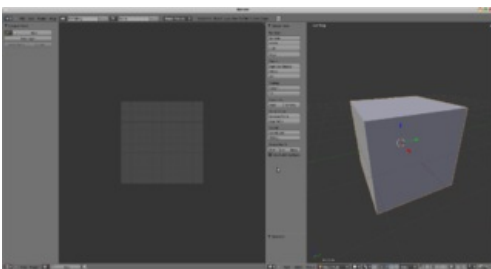
Every point in the UV map corresponds to a vertex in the mesh. The lines joining the UVs correspond to edges in the mesh. Each face in the UV map corresponds to a mesh face.

Each face of a mesh can have many UV Textures. Each UV Texture will have an individual image assigned to it. When you unwrap a face to a UV Texture in the UV/Image Editor, each face of the mesh is automatically assigned *four UV coordinates*: These coordinates define the way an image or a texture is mapped onto the face. These are 2D coordinates, which is why they're called UV, to distinguish them from XYZ coordinates. These coordinates can be used for rendering or for realtime OpenGL display as well.

Every face in Blender can have a link to a different image. The UV coordinates define how this image is mapped onto the face. This image then can be rendered or displayed in realtime. A 3D window has to be in "Face Select" mode to be able to assign Images or change UV coordinates of the active Mesh Object. This allows a face to participate in many UV Textures. A face at the hairline of a character might participate in the facial UV Texture, *and* in the scalp/hair UV Texture.

These are described more fully in the next sections.

Getting Started

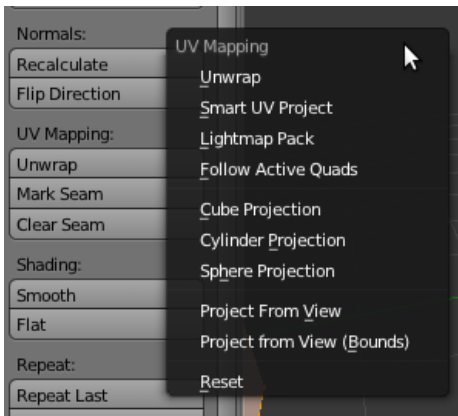


By default, meshes are not created with UVs. First you must map the faces, then you can [edit them](#). The process of unwrapping your model is done within Edit Mode in the 3D View window. This process creates one or more UV Islands in the [UV/Image Editor window](#)

To begin, choose the UV Editing [screen layout](#) from the selection list at the top of your screen in the User Preferences window header. This sets one of the panes to show you the UV/Image Editor window (Shift+f10), and the other pane the 3D window (Shift+f5).

Enter edit mode, as all unwrapping is done in Edit mode. You can be in vertex, face, or edge selection mode.

Workflow



Choosing the unwrapping method

The process for unwrapping is straightforward, but there are tons of options available, each of which dramatically affect the outcome of the unwrap. By understanding the meaning behind the options, you will become more efficient at unwrapping. The process is:

1. Mark Seams if necessary
2. Select all of the mesh components
3. Select a UV mapping method from the UV Unwrap menu
4. Adjust the unwrap settings
5. Add a test image to see if there will be any distortion. See [Applying Images to UVs](#)
6. Adjust UVs in the UV editor. See [Editing UVs](#)

Mapping Types

Blender offers several ways of mapping Uvs. The simpler projection methods use formulas that map 3d space onto 2d space, by interpolating the position of points toward a point/axis/plane through a surface. The more advanced methods can be used with more complex models, and have more specific uses

Basic:

[Cube](#)

Maps the mesh onto the faces of a cube, which is then unfolded.

[Sphere](#)

Projects the Uvs onto a spherical shape. Useful only for spheres or spherical shapes, like eyes, planets, etc.

[Cylinder](#)

Projects Uvs onto a cylindrical surface.

[Project from View](#)

Takes the current view in the 3d viewport and flattens it as it appears

Advanced:

[Unwrap](#)

Useful for organic shapes. Smooths the mesh into a flat surface by cutting along seams.

[Smart UV Project](#)

Breaks the mesh into islands based on an angle threshold

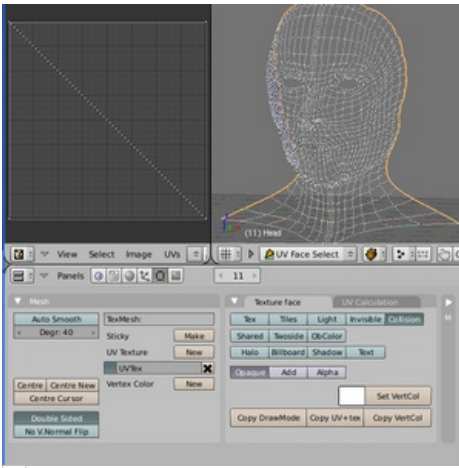
[Lightmap Pack](#)

Separates each face and packs them onto the UV grid

[Follow Active Quads](#)

Follow uv from active quads along continuous face loop

You can also [reset uvs](#), which maps each face to fill the uv grid, giving each face the same mapping.



Selecting Faces in UV Face Select Mode

If we were to use an image that was tileable, the surface would be covered in a smooth repetition of that image, with the image skewed to fit the shape of each individual face. Use this unwrapping option to reset the map and undo any unwrapping (go back to the start).

Basic Mapping

Based on the fundamental geometry of the object, and how it is viewed, the Mesh->UV Unwrap->Cube, Cylinder, and Sphere UV Calculations attempt to unfold the faces for you as an initial best fit. Here, the view from the 3D window is especially important. Also, the settings for cube size or cylinder radius (Editing buttons, UV Calculation panel) should be set (in blender units) to encompass the object.

The following settings are common for the Cube Cylinder and Sphere mappings

Correct Aspect Map Uvs taking image aspect ration into consideration. If an image has already been mapped to the texture space that is non-square, the projection will take this into account and distort the mapping to appear correct. Clip to Bounds Any Uvs that lie outside the 0 to 1 range will be clipped to that range by being moved to the UV space border it is closest to. Scale to Bounds If the UV map is larger than the 0 to 1 range, the entire map will be scaled to fit inside.

Cube

Cube mapping projects s mesh onto six separate planes, creating 6 UV islands. In the UV editor, these will appear overlapped, but can be moved. See [Editing UVs](#).

Cube Size

Set the size of the cube to be projected onto

Cylinder and Sphere

Cylindrical and Spherical mappings have the same settings. The difference is that a cylindrical mapping projects the UVs on a plan toward the cylinder shape, while a spherical map takes into account the sphere's curvature, and each latitude line becomes evenly spaced

Normally, to unwrap a cylinder (tube) as if you slit it lengthwise and folded it flat, Blender wants the view to be vertical, with the tube standing 'up'. Different views will project the tube onto the UV map differently, skewing the image if used. However you can set the axis on which the calculation is done manually. This same idea works for the sphere mapping:

Recall the opening cartographer's approaching to mapping the world? Well, you can achieve the same here when unwrapping a sphere from different perspectives. Normally, to unwrap a sphere, view the sphere with the poles at the top and bottom. After unwrapping, Blender will give you a mercator projection; the point at the equator facing you will be in the middle of the image. A polar view will give a very different but common projection map. Using a Mercator projection map of the earth as the UV image will give a very nice planet mapping onto the sphere.

Direction

View on Poles

Use when viewing from top, at the poles, by using an axis that is straight down from the view

View on Equator

Use if view is looking at the equator, by using a vertical axis

View on Object

Uses the objects transform to calculate the axis

Align

Select which axis is up

Polar ZX

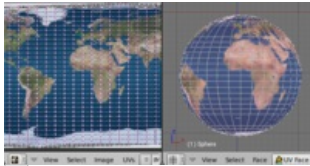
Polar 0 is on the x axis

Polar ZY

Polar 0 is in the y axis

Radius

The radius of the cylinder to use



Using a Mercator image with a Sphere Unwrap

Project From View

In the 3D window, Face->Unwrap UVs->Project from View option maps the face as seen through the view of the 3D window it was selected from. It is almost like you had x-ray vision or squashed the mesh flat as a pancake onto the UV map. Use this option if you are using a picture of a real object as a UV Texture for an object that you have modeled. You will get some stretching in areas where the model recedes away from you.

Using Project from View (Bounds) Will do the same as above, but scale the UVs to the bounds of the UV space.

Resetting UVs

In the 3D window, Face->Unwrap->Reset maps each selected face to the same area of the image, as previously discussed. To map all the faces of an object (a cube for example) to the same image, select all the faces of the cube, and unwrap them using the Reset menu option.

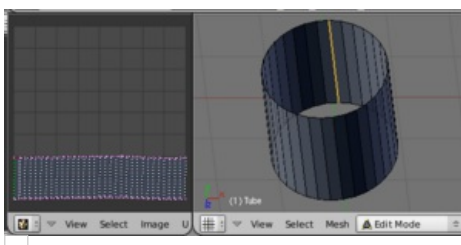
Advanced Mapping

Unwrapping Using Seams

For many cases, using the Unwrap calculations of Cube, Cylinder, Sphere, or best fit will produce a good UV layout. However, for more complex meshes, especially those with lots of indentations, you may want to define a **seam** to limit and guide any of the unwrapping processes discussed above.

Just like in sewing, a seam is where the ends of the image/cloth are sewn together. In unwrapping, the mesh is unwrapped at the seams. Think of this method as peeling an orange or skinning an animal. You make a series of cuts in the skin, then peel it off. You could then flatten it out, applying some amount of stretching. These cuts are the same as seams.

When using this method, you need to be aware of how much stretching there is. The more seams there are, the less stretching there is, but this is often an issue for the texturing process. It's a good idea to have as few seams as possible while having the least amount of stretching. Try to hide seams where they will not be seen. In productions where 3d Paint is used, this becomes less of an issue, as projection painting can easily deal with seams, as opposed to 2d texturing, where it is difficult to match the edges of different UV islands.




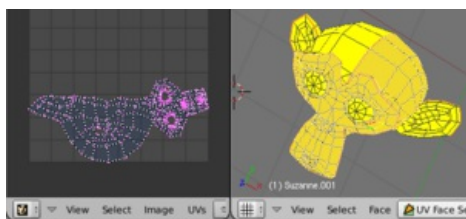
Simple Seam on a Cylinder

The workflow is the following:

1. Create seams. A seam is marked in Edit mode by selecting edges that make the seam and then issuing the command to Mark Seam.
2. Unwrap
3. Adjust seams and repeat
4. Manually adjust Uvs. See the next section on Editing UVs

Marking Seams

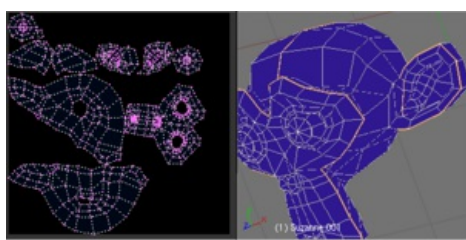
Seams can be marked with Edge selection in Edit Mode. Select the edge(s) that define the seam with border or ⇧ Shift RMB , and press CtrlE or use the Mesh->Edges->Mark Seam menu. In the example to the right, the back-most edge of the cylinder was selected as the seam (to hide the seam), and the default unwrap calculation was used. In the UV/Image Editor window, you can see that all the faces are nicely unwrapped, just as if you cut the seam with a scissors and spread out the fabric.



Oops! Forgot an edge in the seam

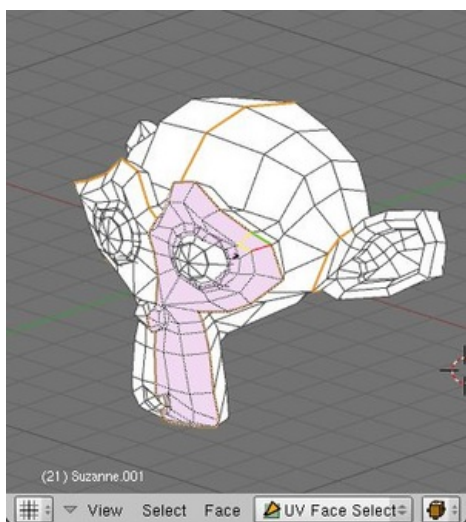
When marking seams, you can use the Select->Linked Faces or CtrlL in Face Select Mode to check your work. This menu option selects all faces connected to the selected one, up to a seam. If faces outside your intended seam are selected, you know that your seam is not continuous. You do not need continuous seams, however. As long as they resolve regions that may stretch

To add an edge to a seam, simply select the edge and CtrlE Mark Seam. To take an edge out of a seam, select it, CtrlE and Clear Seam.



Seamed Suzanne

Just as there are many ways to skin a cat, there are many ways to go about deciding where seams should go. In general though, you should think as if you were holding the object in one hand, and a pair of sharp scissors in the other, and you want to cut it apart and spread it on the table with as little tearing as possible. Note that we seamed the outside edges of her ears, to separate the front from the back. Her eyes are disconnected sub-meshes, so they are automatically unwrapped by themselves. A seam runs along the back of her head vertically, so that each side of her head is flattened out.



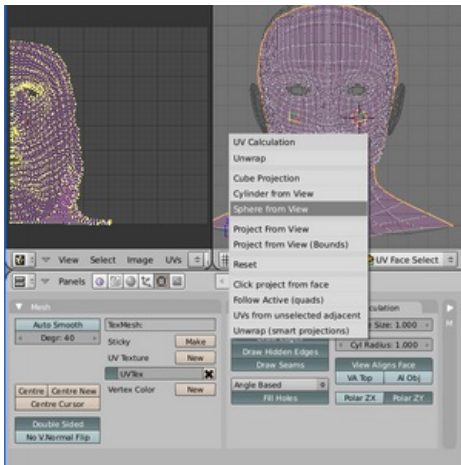
Face Select Mode.

Another use for seams is to limit the faces unwrapped. For example, when texturing a head, you don't really need to texture the scalp on the top and back of the head since it will be covered in hair. So, define a seam at the hairline. Then, when you select a frontal face, and then select linked faces before unwrapping, the select will only go up to the hairline seam, and the scalp will not be unwrapped.

When unwrapping anything that is bilateral, like a head or a body, seam it along the mirror axis. For example, cleave a head or a whole body right down the middle in front view. When you unwrap, you will be able to overlay both halves onto the same texture space, so that the image pixels for the right hand will be shared with the left; the right side of the face will match the left, etc.

Finally, remember that you *don't* have to come up with "one unwrapping that works perfectly for everything everywhere." As we'll discuss later, you can easily have multiple UV unwrappings, using different approaches in different areas of your mesh.

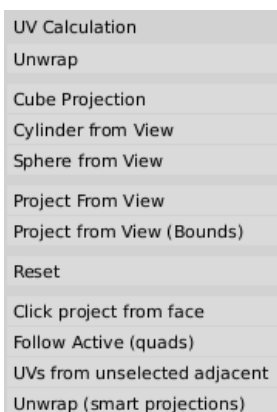
Unwrapping



Unwrapping Faces using 3D View Menu

With our faces selected, it is now time to unwrap them. In the 3D View, select **Face->Unwrap UVs** or **U** and select **Unwrap**.

You can also do this from the UV/Image Editor window with command **UVs->Unwrap** or command **E**. This method will unwrap all of the faces and reset previous work.



Face Unwrap Menu

The **Face->Unwrap->Unwrap** option unwraps the faces of the object to provide the 'best fit' scenario based on how the faces are connected and will fit within the image, and takes into account any seams within the selected faces. If possible, each selected face gets its own different area of the image and is not *tucked under* any other faces. If all faces of an object are selected, then each face is mapped to some portion of the image.

Blender has two ways of calculating the unwrapping. They can be selected in the tool setting in the tool panel in the 3D View.

Angle Based

This method gives a good 2d representation of a mesh.

Conformal

Uses LSCM (Least Squared Conformal Mapping). This usually gives a less accurate UV mapping than Angle Based, but works better for simpler objects.

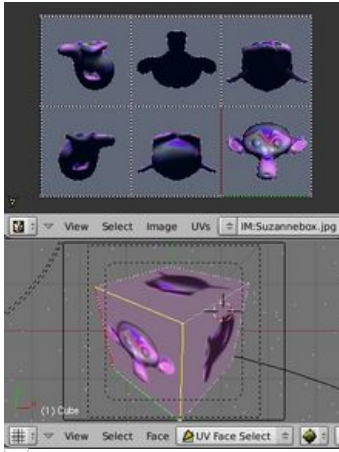
Activating **Fill Holes** will prevent overlapping from occurring and better represent any holes in the UV regions.

This point is crucial to understanding mapping later on: a face's UV image texture only has to use *part* of the image, not the *whole* image. Also, portions of the same image can be shared by multiple faces. A face can be mapped to less and less of the total image.

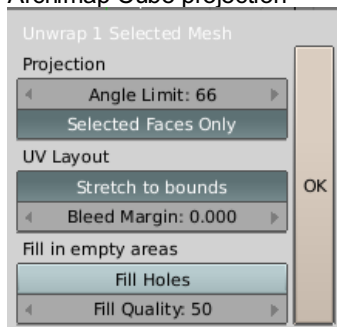
Smart UV Project

Face->Unwrap->Smart UV Project, (which used to be called the Archimapper) gives you fine control over how automatic seams should be created, based on angular changes in your mesh. This method is good for simple and complex geometric forms, such as

mechanical objects or architecture.



Archimap Cube projection



Archimap control panel

This function examines the shape of your object, the faces selected and their relation to one another, and creates a UV map based on this information and settings that you supply.

In the example to the right, the Smart Mapper mapped all of the faces of a cube to a neat arrangement of 3 sides on top, 3 sides on the bottom, for all six sides of the cube to fit squarely, just like the faces of the cube.

For more complex mechanical objects, this tool can very quickly and easily create a very logical and straightforward UV layout for you.

The Tool Settings panel in the Tool Shelf allows the fine control over how the mesh is unwrapped:

Angle Limit

This controls how faces are grouped: a higher limit will lead to many small groups but less distortion, while a lower limit will create less groups at the expense of more distortion.

Island Margin

This controls how closely the UV islands are packed together. A higher number will add more space in between islands.

Lightmap

Lightmap Pack takes each of a meshes faces, or selected faces, and packs them into the UV bounds. Lightmaps are used primarily in gaming contexts, where lighting information is baked onto texture maps, when its is essential to utilize as much UV space as possible. It can also work on several meshes at once. It has several options that appear in the Tool Shelf:

You can set the tool to map just Selected Faces or All Faces if working with a single mesh.

The Selected Mesh Object option works on multiple meshes. To use this, in Object Mode Select several mesh objects, then go into Edit Mode and activate the tool.

Share Tex Space

This is useful if mapping more than one mesh. It Attempts to fit all of the objects' faces in the UV bounds, but not overlapping.

New UV Layer

If mapping multiple meshes, this option creates a new UV layer for each mesh. See [Managing the Layout](#).

New Image

Assigns new images for every mesh, but only one if Shared Tex Space is enabled.

Image Size

Set the size if the new image.

Pack Quality

Pre-packing before the more complex Box packing.

Margin

This controls how closely the UV islands are packed together. A higher number will add more space in between islands.

Follow Active Quads

The Face->Unwrap->Follow Active Quads takes the selected faces and lays them out by following continuous face loops, even if the mesh face is irregularly shaped. Note that it does not respect the image size, so you may have to scale them all down a bit to fit the image area.

Edge Length Mode:

Even

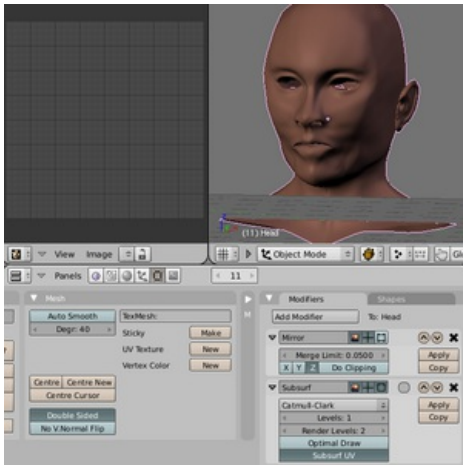
Space all UVs evenly.

Length

Average space UV's edge length of each loop.

Please note that it is the shape of the active quad in UV space that is being followed, not its shape in 3d space. To get a clean 90-degree unwrap make sure the active quad is a rectangle in UV space before using "Follow active quad".

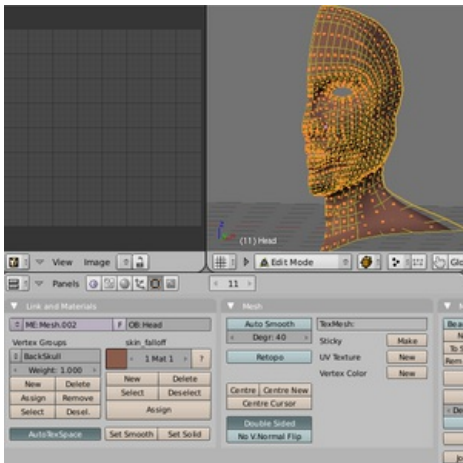
Unwrapping Multiple Faces




Starting Off in Object Mode

In general, you should only unwrap the faces you need to, and do so in a single unwrap operation. You only need to unwrap faces that will be painted using an image; all other faces can use procedural materials and textures or vertex paint. You want to keep your image as small as possible, so that means you want to keep the number of faces as small as possible. For example, if the body is always going to be covered in clothes or armor, there is no need to unwrap it, or they can be mapped separately.

If the back of the head is always going to be covered by hair, there is no need to unwrap the scalp. If you are modeling a chair with an embroidered seat cushion, you only need to unwrap the cushion and not the chair legs. In the example to the right, we only need to unwrap one side of the face, cutting our image size in half, so we leave mirror modifier on; we also do not need to double the number of UV coordinates by applying the Subsurf modifier; we can just leave it as is. Note that at this point, there is no UV Texture in the Mesh panel.



Selecting Faces in Edit Mode

To unwrap multiple faces to a single UV Texture, in Edit Mode ( Tab), enter Face Select mode and select the faces you want.

The example to the right shows that we have hidden many faces from view; the ears and the back of the head. We did so by creating and using the Vertex Groups, selecting the "BackSkull" group and Hiding them from view. We did this because we do not want to unwrap those areas, and we don't want them to get in the way during any further face selection that we may do.

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated **Partial page**

Proposed fixes: none

Managing UV Layouts

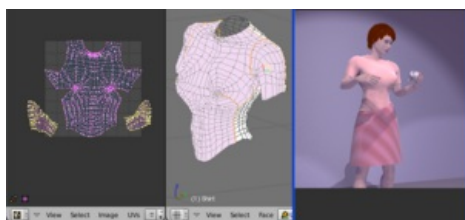
After you finish editing a UV map, you may need to create additional maps on the same object, or transfer a UV map to another mesh.

Transferring UVs

You can copy a Mesh's UV layout to another Mesh with the same geometry/vertex order. This is useful, perhaps if you deleted a UV map from a model by accident, but have an earlier saved file with intact UVs.

To transfer UVs, select the target mesh, then ⇧ Shift select the mesh with the UV map, then do CtrlL » Join as UVs (or go through Object menu » Make Links... » Join as UVs). The target Mesh will now have a UV map that matches the original mesh.

Multiple UV Layouts



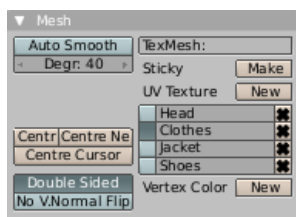
Mesh with Multiple UV Textures

You are not limited to one UV Layout per mesh. You can have multiple UV layouts for parts of the mesh by creating new UV Textures. The first UV Texture is created for you when you select a face in UV Face Select mode. You can manually create more UV Textures by clicking the New button next to "UV Texture" on the Mesh panel in the Buttons Window, Editing Context) and unwrapping a different part of the mesh. Those faces will then go with that UV Texture, while the previously unwrapped faces will still go with the previous UV Texture. Note that if you unwrap the same face twice or more times (each time to a different UV Texture), the coloring for that face will be the alpha combination of the layers of those UV Textures.

In the example to the right, we have a mesh for a blouse. The mesh has been seamed as a normal blouse would, shown in the middle in UV Face Select mode. Wishing to make a cut pattern, the front of the blouse was unwrapped and basic rotation and scaling was done to center it in the UV/Image Editor window. It was then moved off to the side, while the left and right sleeves were unwrapped, each rotated and scaled. Then, select a sample face from each cloth piece, in the 3D View Select->Linked Faces, and the UV/Image Editor will show all those pieces (as shown to the right). You can then work with all pieces for that UV Texture layout. The example shows all three pieces moved onto the image area for painting. As you can see, the pattern nicely fits a square yard of cloth.

Another UV Layout was created by clicking the New button in the Mesh panel, and the process was repeated for the backs of the sleeves and the back of the blouse. Two images, one for the front and one for the back, are used to color the fabric. In this case, some faces map to the first texture, while other faces map to the second texture.

UV Textures List



The Mesh panel (shown to the right) lists the UV Texture maps created for this mesh, and allows you to create New ones as placeholders for future unwrapping operations.

Click the + button to add a new UV texture, and the - to delete an existing one}}. Deleting a UV layout for the mesh destroys all work done in all unwrapping associated the mesh. Click with care. You've been warned.

Each map has a selector button. Click the camera icon to enable that UV texture for rendering. You can change the name by selecting

one and changing the text in the Name box. The selected map is displayed in the UV/Image Editor window. The example shows a few UV maps created for a character, and the map for Clothes is selected.

Note that each texture can be mapped to a specific UV texture. See the [Mapping](#) section of the texture panel.

Page status ([reviewing guidelines](#))

Images

old screenshot

Need to update

Proposed fixes: none

Editing UVs

After unwrap, you will likely need to arrange the UV maps into something that can be logically textured or painted. Your goals for editing are:

- Stitch some pieces (UV maps) back together
- Minimize wasted space in the image
- Enlarge the 'faces' where you want more detail
- Re-size/enlarge the 'faces' that are stretched
- Shrink the 'faces' that are too grainy and have too much detail

With a minimum of dead space, the most pixels can be dedicated to giving the maximum detail and fineness to the UV Texture. A UV face can be as small as a pixel (the little dots that make up an image) or as large as an entire image. You probably want to make some major adjustments first, and then tweak the layout.

Selecting UVs

Selection tools are available in the Select Menu and Header bar, and the shortcuts listed below:

Border Select ; B

Use the box lasso to select UV coordinates.

Select/Deselect All ; A

Selects or de-selects all UV coordinates. When initially unwrapping, you will want to select All UVs to rotate, scale, and move them around.

Linked UVs CtrlL

This menu item selects all UVs that are part of the same UV map. Recall that a map is made for every submesh and seamed part of the mesh, and is analogous to a piece of cloth. Selecting Linked UVs works similarly to the command in 3D View. It will select all UVs that are 'connected' to currently selected UVs.

Pinned UVs ; ⇧ ShiftP

You can pin UVs so they don't move between multiple unwrap operations. This menu item selects them all. See Pinning

Border Select Pinned ; ⇧ ShiftB

Use the box lasso to select only pinned UV coordinates.

Unlink Selection ; AltL

Cuts apart the selected UVs from the map. Only those UVs which belong to fully selected faces remain selected following this command. As the name implies, this is particularly useful to unlink faces and move them elsewhere. The hotkey is analogous to the mesh Separate command.

Selection Modes

Turning on the Sync Selection button in the header causes selection of components in the 3D view to sync with their corresponding elements in the UV editor. This is off by default. These two modes have very different results when transforming components in the UV editor.

When SyncSelection is **Off**: Only selected faces are displayed in the UV editor, and the following selection modes are available:

- Vertex

Select individual vertices

- Edge

Select edges

- Face

Select faces

- Island

Select contiguous groups of Faces

The Sticky Selection Mode menu is available in this mode. This controls how UVs are selected:

Shared Vertex

Selects UVs that share a mesh vertex, even if they are in different UV locations.

Shared Location

Selects UVs that are in the same UV location and share a mesh vertex. This mode is default and works best in most cases.

Disabled

Disables Sticky Selection. When you move a UV in this mode, each face owns its own UVs, allowing them to be separated.

When Sync Selection is **On** the following can be selected:

- Vertex
- Edge
- Face

In this Mode, selection behaves differently. When selecting UVs or Edges, it behaves like Shared Vertex mode above. When selecting Faces, it behaves as in Disabled Sticky Selection above.


Transforming UVs

UVs can be:


- Translated G
- Rotated R
- Scaled S

They can also be hidden or shown using the H and AltH respectively, the same way as in Edit Mode.

Axis Locking

Transformations can be locked to an axis by pressing X or Y after one of the transform tools. Also, holding the MMB  will constrain movement to the X or Y axis.

Pivot Points

The UV editor has a 2D cursor. Its position can be changed by LMB  clicking in the UV editor. You can also manually adjust its position in the Properties Panel. The range by default is from 0 to 256 starting from the lower left corner. By enabling Normalized under Coordinates, the range changes from 0 to 1.

The 2D Cursor can be snapped to nearest pixels or to selected elements, by selecting UVs Menu under Snap.

The Pivot Point can be changed to:

- Bounding Box Center
- Median Point
- 2D Cursor Location

Proportional Editing

Proportional Editing is available in UV editing. The controls are the same as in the 3D view. See [Proportional Editing in 3D](#) for full reference.

Snapping

Snapping in UV is also similar to [Snapping in 3D](#), but only snapping to UVs works, however, the Snap to Pixels option in the UVs Menu will force the UVs to snap to the pixels of an image if loaded.

Additional tools can be found in the UVs Menu under the Snap Submenu:

Snap Pixels

Moves selection to nearest pixel

Snap to Cursor

Moves selection to 2D cursor location

Snap to Adjacent Unselected

Moves selection to adjacent unselected element

Weld and Align

the Weld tool, W1 will move selected UVs to their average position

Align, W2,W3, and W4 will line up selected UVs on the X axis, Y axis, or automatically chosen axis.

Mirror

Components can be mirrored on the Y axis or the X axis. You can select Mirror X and Mirror Y from the Snap sub menu in the UV menu.

You can also use the hotkey CtrlM then enter X or Y, or hold the MMB  and drag in the mirror direction.

Stitch

Stitch, V, will join selected UVs that share Vertices. You set the tool to limit stitching by distance in the Tool Settings, by activating Use Limit and adjusting the Limit Distance

Minimize Stretch

the Minimize Stretch tool, CtrlV Reduces UV stretch by minimizing angles. This essentially relaxes the UVs

Face Mirror and Rotate UVs

Recall how the orientation of the UV Texture is relative to each face? Well, you might find that, for example, the image is upside down or laying on its side. If so, use Face->Rotate UVs (in the 3D window in Face Select mode) menu to rotate the UVs per face in 90-degree turns.

The Face->Mirror UVs to flips the image over like a pancake in a pan, mirroring the UVs per face and showing you the image 'reversed'.

Pinning

When Unwrapping a model it is sometimes useful to "Lock" certain UVs, so that parts of a UV layout stay the same shape, and/or in the same place.

Pinning is done selecting a UV, then by selecting Pin from the UVs menu, or the shortcut P. You can Unpin a UV with the shortcut AltP

Pinning is most effective when using the Unwrap method of UV mapping, for organic objects. An example is when you are modeling a symmetrical object using the [Mirror Modifier](#). Some of the UVs on the mirror axis may be shared across the mirrored counterparts. You could pin the UVs that correspond to the midline, then align them on the X axis, and they will stay in that location.


Pinning also work great with the Live Unwrap tool. If you pin two or more UVs, with Live Unwrap on, dragging pinned UVs will interactively unwrap the model. This helps with fitting a UV island to a certain shape or region.

Optimizing the UV Layout

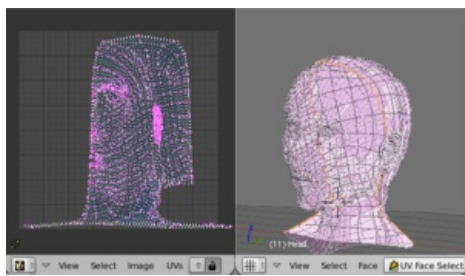
When you have unwrapped, possibly using seams, your UV layout may be quite disorganized and chaotic. You may need to proceed with the following tasks: Orientation of the UV mapping, arranging the UV maps, stitching several maps together.

The next step is to work with the UV layouts that you have created through the unwrap process. If you do add faces or subdivide existing faces when a model is already unwrapped, Blender will add those new faces for you. In this fashion, you can use the UV Texture image to guide additional geometry changes.

When arranging, keep in mind that the entire window is your workspace, but only the UV coordinates within the grid are mapped to the image. So, you can put pieces off to the side while you arrange them. Also, each UV unwrap is its own linked set of coordinates.

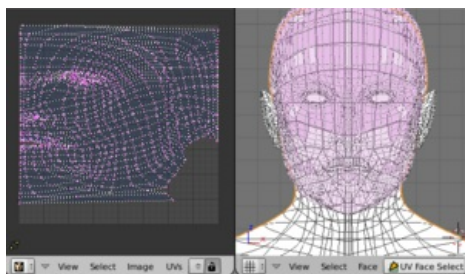
You can lay them on top of one another, and they will onionskin (the bottom one will show through the top one). To grab only one though, RMB  select one of the UV coordinates, and use Select->Linked UVs (CtrlL) to select connected UVs, not border select because UVs from both will be selected.

Combining UV Maps



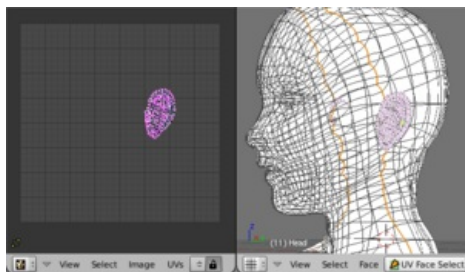
Bad Unwrap-Note Ear and Neck

Very often you will unwrap an object, such as the face example we have been using, and get it 'mostly right' but with parts of the mesh that did not unwrap properly, or are horribly confusing. The picture to the right shows an initial unwrap of the face using the Unwrap from sphere option. The issues are with the ear; it is just a mush of UVs, and the neck, it is stretched and folded under. Too much work to clean up.



Unwrap Face Only, without Ear or Neck

We can tell that the ear would unwrap nicely with just a straightforward projection from the side view, and the neck with a tubular unwrap. So, our general approach will be to unwrap different parts of the object (face, ears, and so on) using different unwrap calculations, selecting each calculation according to whatever works best for that piece. So let's begin: We select only the "face" faces, unwrap them using the *Sphere* calculation, and scale and rotate them somewhat to fit logically within the image area of the UV/Image Editor window pan.

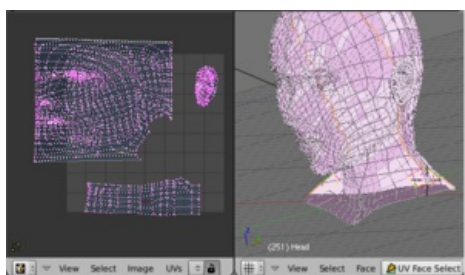


Unwrap Projection: Ear

Once we're satisfied with the face, it's time to turn our attention to the ear. First, unselect the faces you were working with. Their UVs will disappear from the UV/Image Editor, but they are still there, just not shown. (To verify this, you can select a few faces in 3D view and it will show up in the UV/Image Editor.)

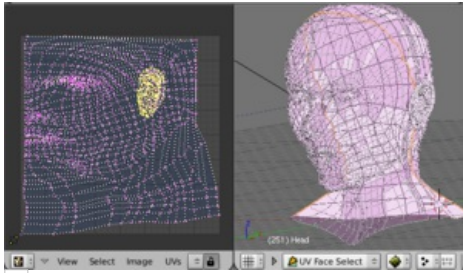
To work on the ear, in the 3D View, we now select only the "ear" faces. You can use Vertex Groups to select the ear faces. Selecting sub-meshes is easy too, since they are not connected to the rest of the mesh. Simply selecting Linked vertices will select that entire submesh. Basically, since you are in edit mode, all of the selecting/unselecting features are available to you.

Now re-unwrap the ear using the *Project* calculation from side view, and scale and rotate them somewhat (discussed in the next section), and place them off to the side. You can do this repetitively, using different UV calculations; each re-calculation just puts those UVs for the selected faces somewhere else. Choose the calculation for each piece that gives you the best fit and most logical layout for subsequent painting of that piece.



UV Maps together

When all of the pieces of the mesh have been unwrapped using the various calculations, you should end up with something that looks like to the Example to the right. All of the sections of the mesh have been mapped, and all those maps are laid out in the same UV Texture map. Congratulations! From here, it is a simple matter of "stitching" (discussed in the next section) to construct the entire UV Map as a single map.



UV Maps Arranged and Stitched

When you have completed arranging and stitching, you will end up with a consolidated UV Map, like that shown to the right, arranged such that a single image will cover, or paint, all of the mesh that needs detailed painting. All of the detailed instructions on how to do this are contained in the next section. The point of this paragraph is to show you the ultimate goal. Note that the mesh shown is Mirrored along the Z axis, so the right side of the face is virtual; it is an exact copy of the right, so only one set of UVs actually exist. (If more realism is desired, the *Mirror* modifier would be applied, resulting in a physical mirror and a complete head. You could then make both side physically different by editing one side and not the other. Unwrapping would produce a full set of UVs (for each side) and painting could thus be different for each side of the face, which is more realistic.)

Average Island Scale

Using the Average Island Scale tool, shortcut CtrlA, will scale each UV island so that they are all approximately the same scale.

Packing Islands

The Pack Islands tool, shortcut CtrlP, will uniformly scale, then individually transform each Island so that they fill up the UV space as much as possible. This is an important tool for efficiently making use of the texture space.

Constraining to Image Bounds

Turning on Constrain to Image Bounds will prevent UVs from being moved outside the 0 to 1 UV range.

Grab/Move	G
Rotate	R
Scale	S
Weld/Align	W
Mirror...	M

UV Transformation
Menu.

Iteration and Refinement

At least for common people, we just don't "get it right the first time." It takes building on an idea and iterating our creative process until we reach that magical milestone called "Done." In software development, this is called the Spiral Methodology.

Applied to Computer Graphics, we cycle between modeling, texturing, animating, and then back to making some modifications to mesh, re-UV mapping, tweaking the animation, adding a bone or two, finding out we need a few more faces, so back to modeling, etc. We continue going round and round like this until we either run out of time, money, or patience, or, in some rare cases, are actually happy with our results.

Refining the Layout

Refinement comes into play when we finally look at our character, and realize that we need more detail in a particular spot. For example, areas around the eyes might need crow's feet, or we need to add a logo to the vest. As you start to edit the image, you realize that there just aren't enough pixels available to paint the detail that you want.

Your only choice is to expand the size (scale out) that UV face. Using the minimize stretch or scale commands, you expand the UV faces around the eyes or chest, allocating more pixels to those areas, but at the same time taking away pixels (detail) from something else, like the back of the head. After refining the UV map, you then edit the image so that it looks right and contains the details you want.

Reusing Textures

Another consideration is the need to conserve resources. Each image file is loaded in memory. If you can re-use the same image on different meshes, it saves memory. So, for example, you might want to have a generic 'face' painting, and use that on different characters, but alter the UV map and shape and props (sunglasses) to differentiate.

You might want to have a "faded blue jeans" texture, and unwrap just the legs of characters to use that image. It would be good to have a generic skin image, and use that for character's hands, feet, arms, legs, and neck. When modeling a fantasy sword, a small image for a piece of the sword blade would suffice, and you would Reset Unwrap the sword faces to re-use that image down the length of the blade.

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Text also splitted

Proposed fixes: none

Applying Images

Sooner or later, you may want to use an image texture on your model. If you are using an external application, you need to know where on the mesh you are painting. You may also need to test your UV mapping with a test image. This section covers how to export an outline of your UV map, and how to load images into the UV editor.

Exporting UV Layout Image

As a way of communicating to an artist who is painting your UV Texture for you, Blender has a tool called Save UV Face Layout (located in the UV/Image Editor Window, UVs->Save UV Face Layout) that saves an image as a Targa (.tga), EPS, or an SVG format for the object you have selected.

The image is an outline of the UV face mapping. Activating the tool brings up the File Browser Window with options for saving the layout:

All UVs

if disabled, then only the UV faces selected will be outlined

Format

Select the type of image file to save.

Size

select the size of the image in pixels. The image be square.

Wire

the thickness of the wire lines that define each face border

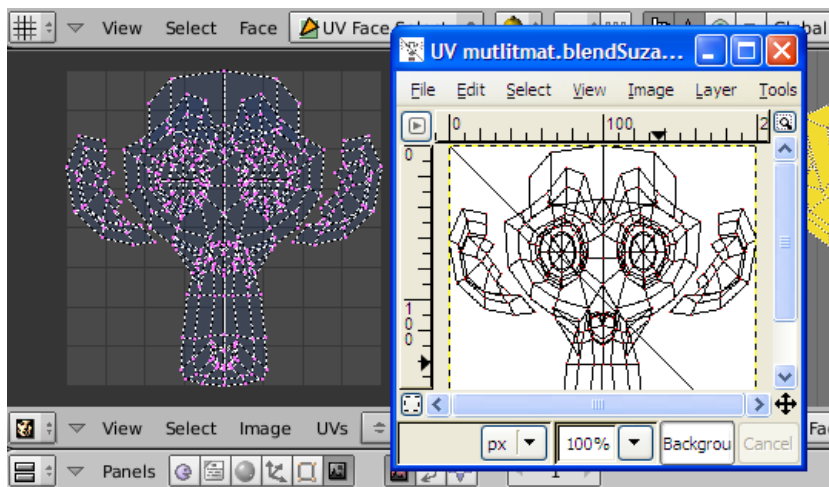
Fill Opacity

Set the opacity of the fill

The image will be lines defining the UV edges that are within the image area of the UV mapping area. Edges outside the boundary, even if selected, will not be shown in the saved graphic.

The artist will use this as a transparent layer in their paint program as a guide when painting your texture. The example below shows Blender in the background, and the Gimp working on the texture, using the saved layout as a guide. Note that targa format supports the Alpha channel, so you can paint transparent areas of the mesh.

For using images as textures, see the page on [Image Textures](#)



Using the layout as a guide in Gimp

Using UV Textures

The UV/Image Editor allows you to map textures directly to the mesh faces. The 3D View window shows you the object being textured. If you set this window into Textured viewport shading, you will immediately see any changes made in the UV/Image Editor window in

this window, and vice versa.

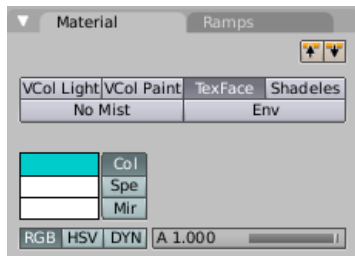
You can edit and load images, and even play a game in the Blender Game Engine with UV textures for characters and object, without a material, and still see them in the 3D window. This is because no 'real' rendering is taking place; it is all just viewport shading. If you were to apply an image to UVs then render, the texture would not show up by default

To render an image however, you must

1. create a Material for the object, and
2. tell Blender to use the UV Textures on faces when rendering.

To create a Material, you have to click Add New Material in the Shading context.

There are two ways to tell Blender to use the UV Texture when rendering: the Proper way and the Quick Way.



The Material panel with activated Face Textures button.

- Quick Way

The quick way is to set up a Face Textures Material as shown. To do so, with the buttons window displayed, press F5 to display the Shader Buttons. In the Buttons window, Material settings, click ADD NEW material.

On the Options panel, enable Face Textures. This way is quick, but bypasses the normal rendering system for fast results, but results which do not respect transparency and proper shading.

- Proper way

In the Texture channel panel F6((shown above), Add a New Texture and define the texture as an image and load the image you want to use. In the Mapping section, choose UV from the Coordinates menu, and select the UV layer to use.

Make sure it is mapped to Color in the Influence section as well (it will be mapped to Color by default, and the UV Texture is named "UVTex" by default). If the image has an alpha channel and you want to use it, click "UseAlpha" in the Map Image panel.

Full details of using Image textures are on the [Image Textures](#) page.

Material is Required for Rendering

You can perform UV Texturing on a mesh within Blender without assigning a material, and you will even see it in your 3D View in textured viewport mode. However, when you render, you will just get a default gray if the object does not have a Material assigned. You will get a black if you do not load an image. If you do not create a texture that uses the image, or enable Face Texture, your object will render according to the procedural material settings.

Loading and Saving Images

In the UV editor, you can assign certain faces certain textures. To do so, first you need an image to work with. In the Image Menu you can open an image file with the File Browser. If you have images in the file already, that you want to use, click the Browse button in the Header, or make a new texture by clicking the New button.

In a team environment, or if you are using an external paint program to edit the image while the .blend file is active, and the file is updated and re-saved, use the UV/Image Editor to Image->Reload it and see the latest and greatest in Blender. Also, use Reload if you have mapped more faces to an image, and the 3D View will be updated with the latest image mapping back to faces.

If you move the image file, Blender may not be able to find it, and you will have to Image->Replace it. Use this option to map a UV layout to a different image altogether.

New Images

When you select New Image you are presented with several options. This Generated image can also be modified afterward in the

Properties Panel:

Image Name

Set the name of the generated image

Width and Height

Set the size of the image in pixels

Color

Sets the default fill color if creating a blank image.

Alpha

Adds an alpha channel to the image

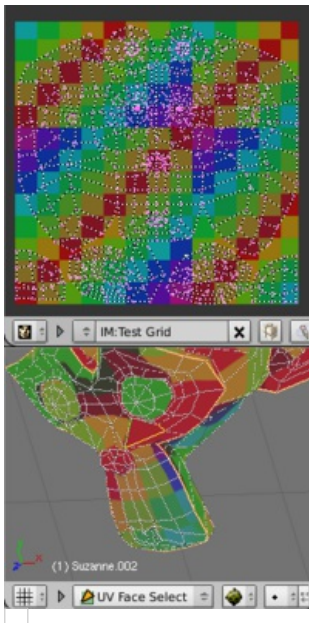
UV Test

Creates a UV Test Grid, which is useful for testing how UVs have been mapped, and to reduce stretching. There are two types available, which can be set after the image has been created.

32 bit

Creates a 32 bit image. This is a larger file size, but holds much more color information than the standard 8 bit image. For close ups and large gradients, it may be better to use a 32 bit image.

Using the Test Grid



Use the UV Test Grid option to check for undue stretching or distortion of faces. If your image is a base uniform pattern and you want the application of that image to your model to look like cloth, you do NOT want any stretching (unless you want the cloth to look like spandex).

When you render, the mesh will have the test grid as its colors, and the UV Texture will be the size image you specified. You can save the UV image using the Image->Save menu.

Image Settings

When an image has been loaded or created in the UV editor, an additional section appears in the Properties Panel. The first row of buttons allow you to:

- Browse for an image
- Change the image name
- Set as Fake User
- Create a New Image
- Open an image
- Unlink Datablock

Select the image type in the Source menu. Each has different options:

Generated

Generates a new image:

Width and Height of image in pixels

Blank

Creates a Blank image

UV grid

Creates a checkerboard pattern with colored plus symbols in each square.

Color Grid

Creates a more complex colored grid with letters and numbers denoting locations in the grid.

File

Use for loading image files:

Fields

Use if image is made of fields. You can set it to use Upper First or Lower First

Premultiply

Converts RGB from key alpha to premultiplied alpha.

Movie and Sequence

Frames

Set the number of frames to use

Start

Set the starting frame of the movie/sequence

Offset

Offset the number of frame used in the animation

Fields

Set the number fields per rendered frame to use(2 fields is 1 frame)

Auto Refresh

Always refresh images on frame changes.

Cyclic

Cycle the images in a movie/sequence.

Modifying your Image Texture

To modify your new Texture, you can:

- use the UV Painter script to create an image from vertex colors,
- Render Bake an image based on how the mesh looks,
- paint using Texture Paint,
- use external software to create an image,
- use the "projection painting" feature of recent versions of Blender, or
- some combination of the above.

The first three options, (UV Painter, Render Bake, and Texture Baker) replace the image with an image that they create. Texture paint and external software can be used to add or enhance the image. Regardless of which method you use, ultimately you must either

- save your texture in a separate image file (for example JPG for colors, PNG with RGBA for alpha),
- pack the image inside the blend file (UV/Image Editor Image->Pack as PNG),
- or do both.

The advantage to saving as a separate file is that you can easily switch textures just by copying other image files over it, and you can use external editing programs to work on it. The advantage of packing is that your whole project is kept in the .blend file, and that you only have to manage one file.

You can invert the colors of an image by selecting the Invert menu. in the Image menu

Replacing an image via Render Bake

The [Render Bake](#) feature provides several tools to replace the current image based on a render of:

- [Vertex Paint](#) colors
- Normals (bumps)
- Procedural materials, textures and lighting
- Ambient Occlusion

Create/Modify via an External Image Paint Program

Using your favorite image painting program, you could use an exported UV layout to create a texture. Then save your changes, and back in Blender, use the Image->Open menu command to load it as your UV image for the mesh in Face Select Mode for the desired (and active) UV Texture layer.

Using the Edit Externally tool in the Image menu, Blender will open an image editor, as specified in the User Preferences and load in the image to be edited.

Modify an image via Texture Paint

Use the UV/Image Editor menu *Image->New*. Then start painting your mesh with [Texture Paint](#).

Saving Images

Images can be saved to external files if they were created or edited in Blender with tools in the Image menu. If images are already files, use the Save command (AltS). You can also Save As (F3) if the image was generated or you want to save as a different name. Using Save as Copy, (F3) will save the file to a specified name, but will keep the old one open in the Image editor.

Assigning to Faces

To assign a texture to a face, select desired faces in face selection mode in the UV window. If they are not assigned a texture, the background should be blank. With the face or faces selected, click on the Browse icon in the header and select an image, or load one in.

If you only have some faces assigned, clicking on an unassigned one will clear the image from the background, however, by enabling Image Pinning by clicking the pin icon in the header, the currently displayed image will stay, regardless of the selection.

Replacing the active Image

Recall that each face gets coordinates and a link to an image. To map a face to a different image, simply select that face (or faces) and use the UV/Image Editor window Image}} menu to Replace the current image with an existing file (such as a JPG or PNG file).

Packing Images inside the Blend file

If you pack your .blend file, the current version of all UV Texture images are packed into the file. If those files later change, the updates will not be automatically re-packed; the old version of the image is what will be used. To update, you will have to re-pack or reload.

To pack an image, select Pack Image from the Image menu. To Unpack, select this option again and select Remove Pack.

The File->Append function automatically goes into .blend files and shows you the image textures packed in it. The public domain Blender Texture CD is also a great resource, and there are many other sources of public domain (and licensed) textures. All textures on the Elephants Dream CD are liberally licensed under [CC-BY 2.5](#).

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Void page

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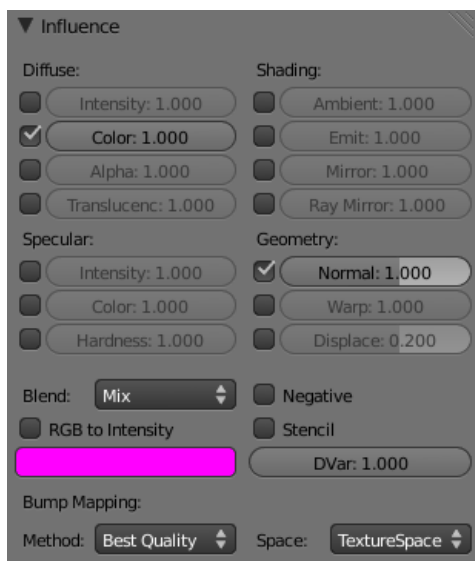
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Material Textures Influence

Not only can textures affect the color of a material, they can also affect many of the other properties of a material. The different aspects of a material that a texture influences are controlled in the Influence panel.

Surface and Wire materials



Texture Influence panel for a Surface material

Note

Texture options for Surface and Wire materials and in some cases also for Volume and Halo materials.

Diffuse

Intensity

Amount texture affects affects diffuse reflectivity

Color

Amount texture affect the basic color or RGB value of the material

Alpha

Influences the opacity of the material. See [Use Alpha for Object Transparency](#). Also use Z Transparency for light and if combining multiple channels.

Translucency

Influences the Translucency amount.

Specular

Intensity

Amount texture affect specular reflectivity

Color

Influences the Specular color, the color of the reflections created by the lamps on a glossy material.

Hardness

Influences the specular hardness amount. A DVar of 1 is equivalent to a Hardness of 130, a DVar of 0.5 is equivalent to a Hardness of 65.

Shading

Ambient

Influences the amount of Ambient light the material receives.

Emit

Influences the amount of light Emitted by the material.

Mirror

Influences the mirror color. This works with environment maps and raytraced reflection.

Ray Mirror

Influences the strength of raytraced mirror reflection.

Geometry

Normal

Commonly called bump mapping, this alters the direction of the surface normal. This is used to fake surface imperfections or unevenness via bump mapping, or to create reliefs.

Warp

Warp allows textures to influence/distort the texture coordinates of a next texture channel. The distortion remains active over all subsequent channels, until a new Warp has been set. Setting the factor at zero cancels out the effect.

Displace

Influences the Displacement of vertices, for using [Displacement Maps](#).

Blending

Blend

How this channel interacts with other channels below it. See [Compositing Mix Node](#) for information and examples on the effect of each mixing mode.

RGB to intensity

With this option, an RGB texture (affects color) is used as an intensity texture (affects a value).

Blend Color

If the texture is mapped to Col, what color is blended in according to the intensity of the texture? Click on the swatch or set the RGB sliders.

Negative

The effect of the Texture is negated. Normally white means on, black means off, Negative reverses that.

Stencil

The active texture is used as a mask for all following textures. This is useful for semitransparent textures and "Dirt Maps". Black sets the pixel to "untexturable". The Stencil mode works similar to a layer mask in a 2D program. The effect of a stencil texture can not be overridden, only extended. You need an intensity map as input.

DVar

Destination Value (not for RGB). The value with which the Intensity texture blends with the current value. Two examples:

- The Emit value is normally 0. With a texture mapped to Emit you will get maximal effect, because DVar is 1 by default. If you set DVar to 0 no texture will have any effect.
- If you want transparent material, and use a texture mapped to Alpha, nothing happens with the default settings, because the Alpha value in the Material panel is 1. So you have to set DVar to 0 to get transparent material (and of course Z Transparency also). This is a common problem for beginners. Or do it the other way round - set Alpha to 0 and leave Dvar on 1. Of course the texture is used inverted then.

Bump Mapping

Settings for bump mapping.

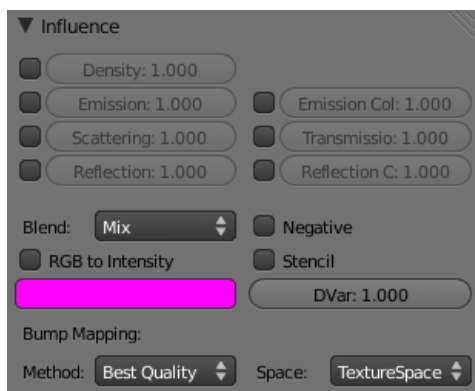
Method

Best Quality, Default, Compatible, Original

Space

Texture Space, Object Space, View Space

Volume materials



Texture Influence panel for Volume material

Special texture options for Volume materials

Density

Causes the texture to affect the volume's density.

Emission

Causes the texture to affect the volume's emission.

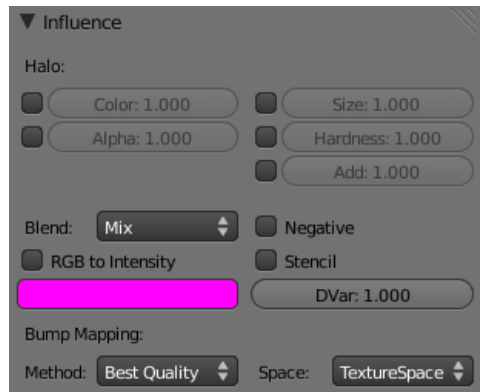
Scattering

Amount the texture affects scattering.

Reflection

- Amount the texture affects brightness of out-scattered light
- Emission Color
 - Amount the texture affects emission color.
- Transmission
 - Amount the texture affects result color after light has been scattered/absorbed.
- Reflection Color
 - Amount the texture affects color of out-scattered light.

Halo materials



Texture Influence panel for a Halo material

Special texture options for Halo materials

Size

Amount the texture affects ray mirror.

Hardness

Amount the texture affects hardness.

Add

Amount the texture affects translucency.

Bump and Normal Maps

Description

Normal Maps and Bump Maps both serve the same purpose: they simulate the impression of a detailed 3D surface, by modifying the shading as if the surface had lots of small angles, rather than being completely flat. Because it's just modifying the shading of each pixel, this will not cast any shadows and will not obstruct other objects. If the camera angle is too flat to the surface, you will notice that the surface is not really shaped.

Both Bump Maps and Normal Maps work by modifying the normal angle (the direction pointing perpendicular from a face), which influences how a pixel is shaded. Although the terms Normal Map and Bump Map are often used synonymously, there are certain differences.

Bump maps

These are textures that store an **intensity**, the relative height of pixels from the viewpoint of the camera. The pixels seem to be moved by the required distance in the direction of the face normals. (The "bump" consists only of a displacement, which takes place along the existing, and unchanged, normal-vector of the face.) You may either use greyscale pictures or the intensity values of a RGB-Texture (including images).

Normal maps

These are images that store a **direction**, the direction of normals directly in the RGB values of an image. They are much more accurate, as rather than only simulating the pixel being away from the face along a line, they can simulate that pixel being moved at any direction, in an arbitrary way. The drawbacks to normal maps are that unlike bump maps, which can easily be painted by hand, normal maps usually have to be generated in some way, often from higher resolution geometry than the geometry you're applying the map to.

Normal maps in Blender store a normal as follows:

- Red maps from (0-255) to X (-1.0 - 1.0)
- Green maps from (0-255) to Y (-1.0 - 1.0)
- Blue maps from (0-255) to Z (0.0 - 1.0)

Since normals all point towards a viewer, negative Z-values are not stored (they would be invisible anyway). In Blender we store a full blue range, although some other implementations also map blue colors (128-255) to (0.0 - 1.0). The latter convention is used in "Doom 3" for example.

Workflow

The steps involved in making and using Bump and Normal Maps is:

1. Model a highly detailed ("hi-poly") model
2. Bake the Bump and/or Normal maps
3. Make a low-poly, less detailed model
4. Map the map to the low-poly model using a common coordinate system

Consult the Modeling section for how to model a highly detailed model using the Mesh tools. How much detail you put in is totally up to you. The more ridges and details (knobs, creases, protrusions) you put in, the more detailed your map will be.

Baking a map, simply put, is to take the detail of a high polygon mesh, and apply it to a similar object. The similar object is identical to the high-poly mesh except with less vertices. Use the [Render Bake](#) feature in Blender to accomplish this.

Modeling a low-poly using Blender's Mesh editing tools. In general, the same or similar faces should exist that reflect the model. For example, a highly detailed ear may have 1000 faces in the high-poly model. In the low-poly model, this may be replaced with a single plane, oriented in the same direction as the detailed ear mesh. (*Tip*: Blender's [multi-resolution mesh](#) modeling feature can be used to good effect here.)

Mapping is the process of applying a texture to the low-poly mesh. Consult the [Textures Mapping section](#) for more information on applying a texture to a mesh's material. Special considerations for Bump and Normal Maps is:

- When using a Bump map, map the texture to Normal and enable No RGB.
- When using a Normal map, map the texture to Normal.

The coordinate systems of the two objects must match. For example, if you bake using a UV map of the high-poly model, you must UV map the low poly model and line up its UV coordinates to match the outline of the high-poly image (see [UV unwrapping](#) to line up with the high-poly map edges).

Displacement Maps

Description

Displacement mapping allows a texture input to manipulate the position of vertices on rendered geometry. Unlike [Normal or Bump mapping](#), where the shading is distorted to give an illusion of a bump (discussed on the previous page), Displacement Maps create real bumps, creases, ridges, etc in the actual mesh. Thus, the mesh deformations can cast shadows, occlude other objects, and do everything that changes in real geometry can do, but, on the other hand, requires a lot more vertices to work.

Options

In the [Influence panel](#), the strength of the displacement is controlled by the Displace and Normal sliders.

- If a texture provides only normal information (e.g. Stucci), vertices move according to the texture's normal data. The normal displacement is controlled by the Normal slider.
- If a texture provides only intensity information (e.g. Magic, derived from color), vertices move along the directions of their normals (a vertex has no normal itself, it's the resulting vector of the adjacent faces). White pixels move outward in the direction of the normal, black pixels move in the opposite direction. The amount of displacement is controlled with the Displace slider.

The two modes are not exclusive. Many texture types provide both information (Clouds, Wood, Marble, Image). The amount of each type can be mixed using the respective sliders. Intensity displacement gives a smoother, more continuous surface, since the vertices are displaced only outward. Normal displacement gives a more aggregated surface, since the vertices are displaced in multiple directions.

The depth of the displacement is scaled with an object's scale, but not with the relative size of the data. This means if you double the size of an object in object mode, the depth of the displacement is also doubled, so the relative displacement appears the same. If you scale inside Edit Mode, the displacement depth is not changed, and thus the relative depth appears smaller.

Hints

Displacement maps move the rendered faces, not the physical mesh faces. So, in 3D View the surface may appear smooth, but render bumpy. To give a detailed surface, there has to be faces to displace and have to be very small. This creates the trade-off between using memory and CPU time versus render quality.

From best to worst, displacement works with these object types using the methods listed to control the render face size:

[Subdivision Surface Meshes](#)

Rendered face size is controlled with render subsurf level. Displacement really likes smooth normals.

Manually (Edit Mode) [subdivided](#) meshes

Control render faces with number of subdivides. (This can be combined with the above methods.) Displaces exactly the same Simple Subsurf, but slows editing down because of the OpenGL overhead of drawing the extra faces. (You can't turn the edit subdivide level down this way).

[Meta Objects](#)

Control render faces with render wiresize. Small wire == more faces.

The following are available, but currently don't work well. It is recommended that you convert these to meshes before rendering.

Open [NURBS Surfaces](#)

Control render faces with U/V Surface Resolution. Higher numbers give more faces. (Note normal errors).

Closed NURBS Surfaces

Control with Surface Resolution controls. (Note the normal errors, and how implicit seam shows).

[Curves and Text](#)

Control with Surface Resolution controls. Higher gives more render faces. (Note that the large flat surfaces have few render faces to displace).

Displace Modifier

If you want more control over your displacement, you'll probably want to use the [Displace Modifier](#). This feature has lots of different options so that you can customize the displacement exactly to your liking.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

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Void page

Proposed fixes: none

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Page status ([reviewing guidelines](#))

Partial page Text missing some words on options that are explain in lighting and no explanation about Gather
Proposed fixes: none

World



World panel

Blender provides a number of very interesting settings to complete your renderings by adding a nice background, and some interesting 'depth' effects. These are accessible via the World context. By default a very plain uniform world is present. You can edit it or add a new World.

You have:

[Background](#)

The color and texture of the world background, with special settings for mapping coordinates.

[Mist](#)

Add a mist to your scene to enhance the feeling of depth.

[Stars](#)

Randomly covers the background with halo-like dots.

While these world settings offers a simple way of adding effects to a scene, [compositing nodes](#) are often preferred, though more complex to master, for the additional control and options they offer. For example, filtering the Z value (distance from camera) or normals (direction of surfaces) through compositing nodes can further increase the depth and spacial clarity of a scene.

Note

Some of the settings under the World panel in Blender affect lighting so you find them under the [Lighting](#) chapter (see [Ambient Light](#), [Exposure](#) and [Ambient Occlusion](#)). When using a Sun Lamp options for Sky & Atmosphere are available in the Lamp menu.

Page status ([reviewing guidelines](#))

Partial page Text missing Ambient Color, Exposure and Range
Proposed fixes: none

World Background

Description

The world buttons let you set up the shading of your scene in general. It can provide ambient color, and special effects such as mist, but a very common use of a World is to shade a background color.

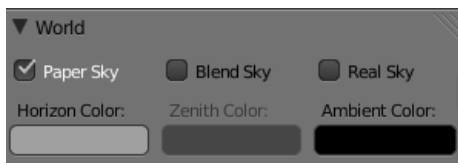
Background Image in Render

To use an image as your render background, see [BackBuf images specified in the Output Panel](#)

Background Image in 3D

To use an image as a background image in your 3D view, for example as a reference when doing a model, see [using a Background Image](#)

Options



World panel

Horizon Color

The RGB color at the horizon

Zenith Color

The RGB color at the zenith (overhead)

How these colors are interpreted depends on which kind of Sky is chosen.

None Enabled

If none of these three buttons is checked, your background will just be plain flat color (using the horizon one).

Paper Sky

If this option is added, the gradient keeps its characteristics, but it is clipped in the image (it stays on a horizontal plane (parallel to x-y plane): what ever the angle of the camera may be, the horizon is always at the middle of the image).

Blend Sky

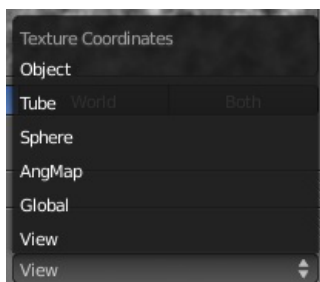
The background color is blended from horizon to zenith. If only this button is pressed, the gradient runs from the bottom to the top of the rendered image regardless of the camera orientation.

Real Sky

If this option is added, the gradient produced has two transitions, from nadir (same color as zenith) to horizon to zenith; the blending is also dependent on the camera orientation, which makes it more realistic. The horizon color is exactly at the horizon (on the x-y plane), and the zenith color is used for points vertically above and below the camera.

Textures

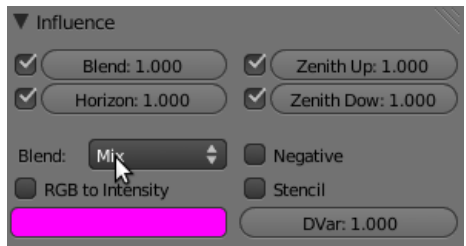
Instead of a color, or blend of two colors, Blender can use an 2D image which it maps to a very large Box or sphere which encompasses the entire scene, or which it maps to a virtual space around the scene.



Texture Coordinates popup menu

The World textures are accessible in the texture menu (just select World first, then Texture. They are used much like the Materials textures, except for a couple of differences. The textures can be mapped according to:

- View
 - The default orientation, aligned with the co-ordinates of the final render
- Global
 - Uses global coordinates
- AngMap
 - Used to wrap a standard hemisphere angular map around the scene in a dome. This can be used for image based lighting with Ambient Occlusion set to sky color. You'll generally need a high dynamic range image (HDRI) angular map (the look like a weird spherical image).
- Sphere
 - Sphere mapping, similar to that of materials
- Tube
 - Wrap the rectangular texture around in a cylinder, similar to that of materials
- Object
 - Position the texture relative to a specified object's local texture space



Texture Influence panel

The texture affects color only, but in four different ways:

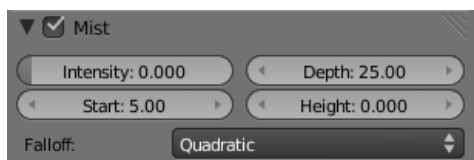
- Blend
 - Makes the Horizon color appear where the texture is non-zero
- Horizon
 - Affect the color of the horizon
- Zenith Up
 - Affect the zenith color overhead
- Zenith Down
 - Affect the zenith color underneath

Mist

Description

Mist can greatly enhance the illusion of depth in your rendering. To create mist, Blender makes objects farther away more transparent (decreasing their Alpha value) so that they mix more of the background color with the object color. With Mist enabled, the further the object is away from the camera the less its alpha value will be.

Option



Mist panel

Mist check box

Toggles mist on and off

Minimum

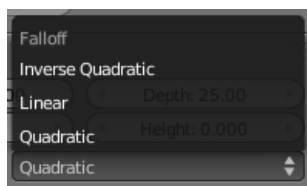
An overall minimum intensity, or strength, of the mist.

Start

The distance from the camera at which the mist starts to fade in

Depth

The distance from Start of the mist, that it fades in over. Objects further from the camera than Start+Depth are completely hidden by the mist.



Mist Falloff popup menu

Height

Makes the mist intensity decrease with height, for a more realistic effect. If greater than 0, it sets, in Blender units, an interval around z=0 in which the mist goes from maximum intensity (below) to zero (above).

Falloff

The decay rate of the mist (Quadratic/Linear/Inverse Quadratic). These settings control the rate of change of the mist's strength further and further into the distance.

Mist distances

To visualize the mist distances in the 3D View, select your camera, go to the camera menu, and enable Show Mist.

The camera will show mist limits as a line projecting from the camera starting from Start and of distance Depth.

To get a better view to evaluate the Mist visualization, ⇧ ShiftNum1 with the camera selected (Num5 to toggle perspective view on and off). This will place the 3D view right over the camera looking down.

Transparency

Because Mist works by adjusting transparency, this can sometimes cause objects to be partially transparent when they shouldn't be. One workaround is to set the Mist settings as desired, but turn Mist off. The Mist data is still available for compositing even though it is off. Use [Do Composite](#) and the [Nodes Editor](#) to feed the Mist pass to an [AlphaOver](#) to blend the background color (or a render layer with just the sky) with the rendered image. This produces the mist effect but since Mist is off the object transparency (or lack of) is preserved.

Examples



Mist example

In this example ([.blend](#)) the Mist Height options has been limited to create smoke covering the floor.

This simple scene was inspired by [Stefan Morell's Arc Sci-Fi Corridor](#).

Page status ([reviewing guidelines](#))

Partial page Text missing example
Proposed fixes: none

Stars

Description

Stars are randomly placed halo-like objects which appear in the background.

Options



Star panel

Size

The actual size of the star halo. It is better to keep it much smaller than the proposed default, to keep the material smaller than pixel-size and have pin-point stars. This is much more realistic.

Colors

Adds a random hue to the otherwise plain white stars.

Min. Dist

The *minimum* distance from the camera at which stars are placed. This should be greater than the distance from the camera to the *furthest* object in your scene, unless you want to risk having stars *in front* of your objects.

Separation

The *average* distance between stars. Stars are intrinsically a 3D feature, they are placed in space, not on the image.

Introduction

After completing your character you need a way to manipulate it for animation or just for posing, that's where rigging comes to scene.

Rigging is the process of attaching a skeleton to your character mesh object so you can deform and pose it in different ways. These do not fundamentally alter the mesh, and can easily be changed, undone, or combined with other poses.

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Armatures

Armature is the object type used for rigging and it borrows many ideas from real life skeletons.

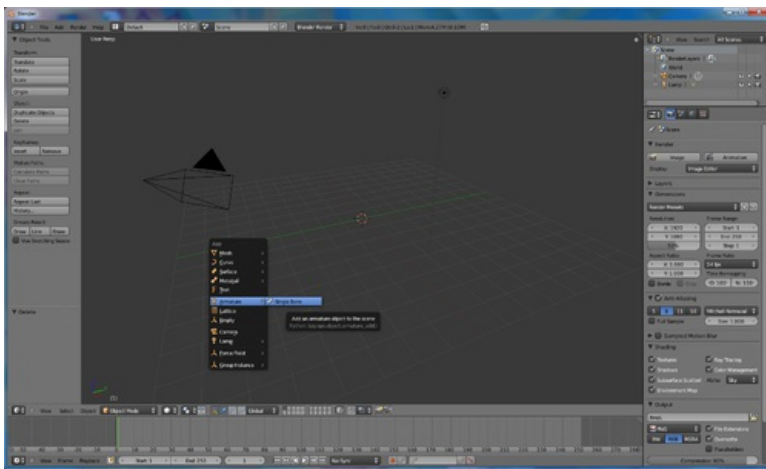
Your first armature

In order to see what we're talking about, let's try to add the default armature in Blender.

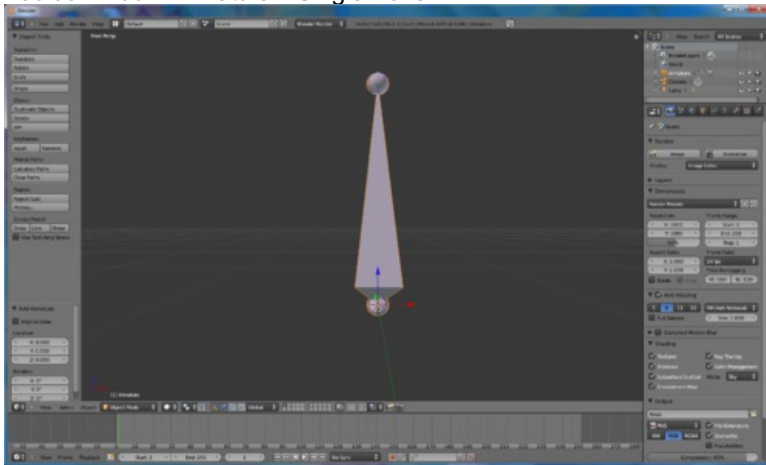
(Note that armature editing details are explained in the [armatures editing section](#)).

Open a default scene, then:

- delete all objects in the scene
- make sure the cursor is in the world origin with ⇧ ShiftC
- press 1 NumPad to see the world in Front view
- then, either:
 - in the Main Menu, Go to Add > Armature > Single Bone
 - -or- in the 3D view, add an armature with ⇧ ShiftA » Armature » Single Bone
- press ⌘ Home to see the armature at maximum zoom



Toolbox: Add » Armature » Single Bone



The default armature

The armature object

As you can see, an armature is like any other object type in Blender:

- It has a center, a position, a rotation and a scale factor.
- It has an ObData datablock, that can be edited in Edit mode.
- It can be linked to other scenes, and the same armature data can be reused on multiple objects.
- All animation you do in Object mode is only working on the whole object, not the armature's bones (use the Pose mode to do this).

As armatures are designed to be posed, either for a static or animated scene, they have a specific state, called "rest position". This is

the armature's default "shape", the default position/rotation/scale of its bones, as set in Edit mode.

In Edit mode, you will always see your armature in rest position, whereas in Object and Pose mode, you usually get the current "pose" of the armature (unless you enable the Rest Position button of the Armature panel).

Armature chapter overview

In the "Armatures" section, we will only talk about armatures themselves, and specifically we will talk about:

- the armature object [panels](#)
- the basics of [bones](#)
- the different [armature visualizations](#)
- the armature [structure types](#)
- how to [select](#) its parts,
- how to [edit an armature](#)
- how to [Edit Bones](#)
- how to [edit bones properties](#)
- how to sketch armatures with the [Etch-a-Ton tool](#)
- how to use [templates](#)

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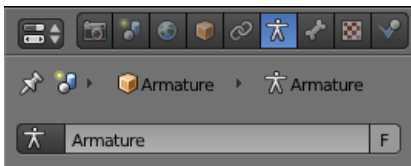
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Armature Panels Overview

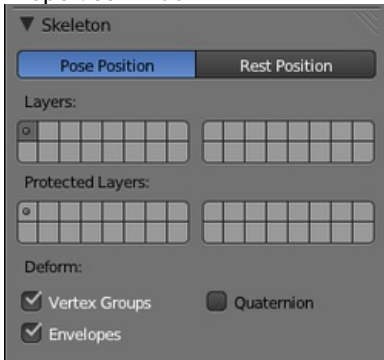
Mode: Object mode, Edit mode and Pose mode

Panel: All in Properties window, Object data property

Let's first have a general grasp of the various panels gathering the armature settings, in Properties window, Object data context:



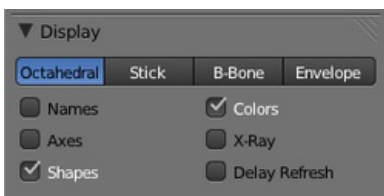
The Object data property in the Properties window.



The Skeleton panel.

Skeleton panel (all modes)

In this panel you can arrange sets of bones in different layers for easier manipulation.

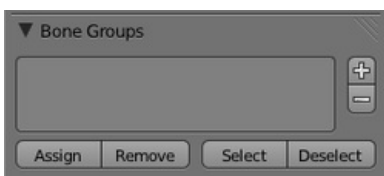


The Display panel.

Display panel (all modes)

This controls the way the bone appears in 3D view, you have 4 different sets you can use.

There are several other options available which we will cover later on.



The Bone Groups panel.

Bone groups panel (pose mode)

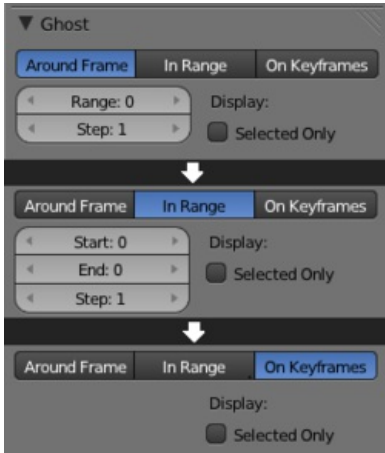
Lets you assign a set of bones to groups for easy manipulation and management.



The Pose Library panel.

Pose Library panel (Pose mode)

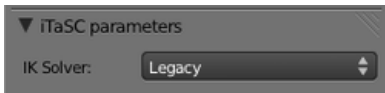
Allows you to save different poses for later use.



The Ghost panel.

Ghost panel (all modes)

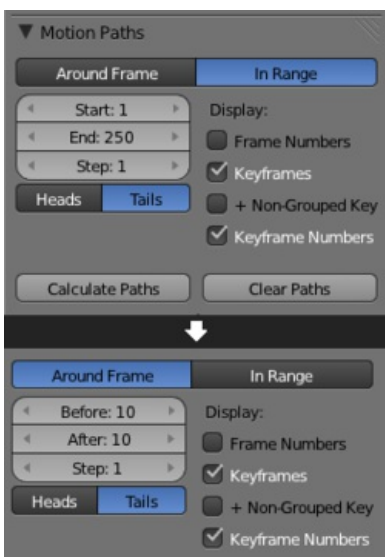
Allows you to see a set of different consecutive poses, very useful when animating.



The iTaSC parameters panel.

iTaSC parameters panel (all modes)

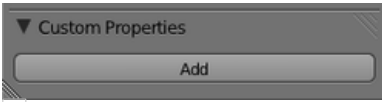
Defines the type of IK solver used in your animation.



The Motion Paths panel.

Motion Paths panel (Pose mode)

In this panel you can enable visualization of the motion path your skeleton leaves when animated.



The Custom Properties panel.

Custom Properties panel (all modes)

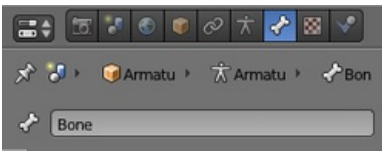
Panel for defining custom properties, this is used when scripting.

Bone Panels Overview

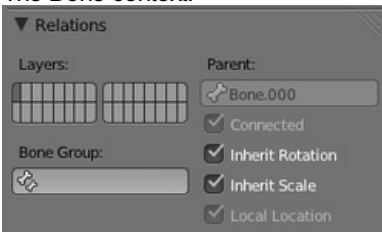
Mode: Object mode, Edit mode and Pose mode

Panel: All in Properties window, Bone property

Let's first have a general grasp of the various panels gathering the bone settings, in Properties window, Bone context:



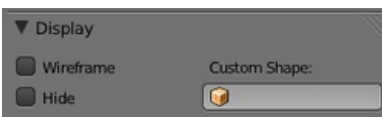
The Bone context.



The Relations panel.

Relations panel (edit mode)

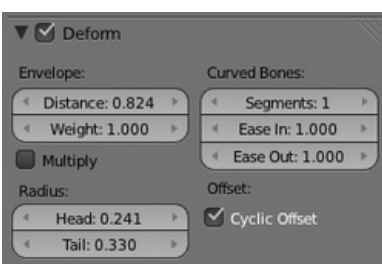
In this panel you can arrange sets of bones in different layers for easier manipulation.



The Display panel.

Display panel (object mode)

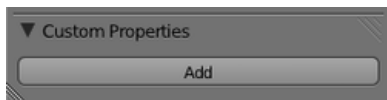
Display panel lets you customize the look of your bones taking the shape of a another existing object.



The Deform panel.

Deform panel (all modes)

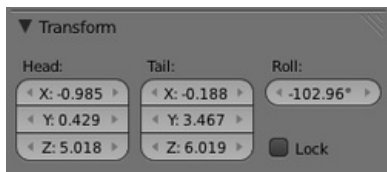
In this panel you can set basic properties of the bones.



The Custom Properties panel.

Custom Properties panel (all modes)

Panel for defining custom properties, this is used when scripting.

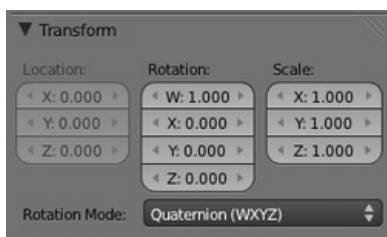


The Transform panel(edit mode).

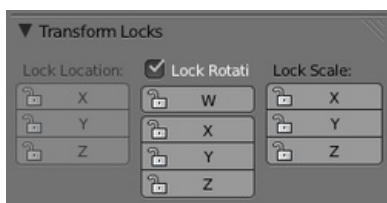
Transform panel (edit and pose mode)

When in edit mode you can use this panel to control position and roll of individual bones.

When in pose mode you can only set location for the main bone, and you can now set rotation and scale.



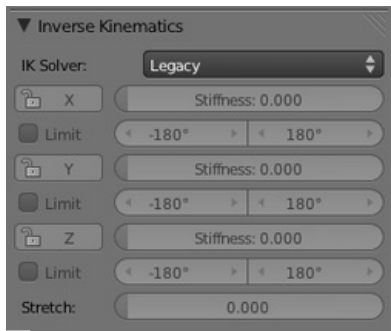
The Transform panel(pose mode).



The Transform Locks panel.

Transform Locks panel (pose mode)

This panel appears only in pose mode and allows you to restrict position, rotation and scale by axis on each bone in the armature.

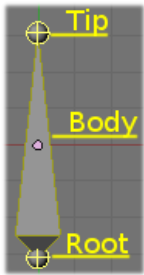


The Inverse Kinematics panel.

Inverse Kinematics panel (pose mode)

This panel controls the way a bone or set of bones behave when linked in an inverse kinematic chain.

Bones



☐ The elements of a bone.

Bones are the base elements of armatures.

They have three elements:

- the “start point” named **root** or **head**,
- the “body” itself,
- and the “end point” named **tip** or **tail**.

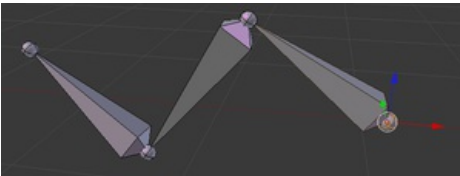
Select the [default armature](#) and press ⇐ Tab to enter Edit mode. As you can see, in this mode you can select the root and the tip, and move them as you do with mesh vertices (don't lose too much time here though, specific pages about selecting and editing will come later).

Both root and tip (the “ends”) define the bone by their respective position.

They also have a radius property, only useful for the envelope deformation method (see below).

Bones Visualization

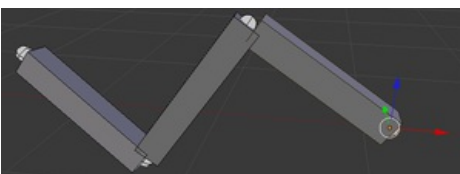
Bones can be visualized in different forms (Octahedron, Stick, B-Bone and Envelope), and even in custom shapes you define yourself!



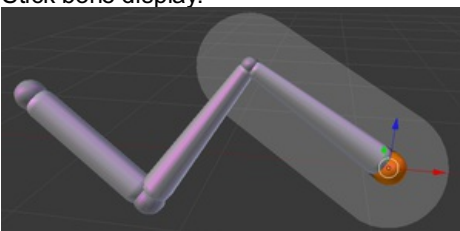
☐ Octahedral bone display.



☐ Stick bone display.



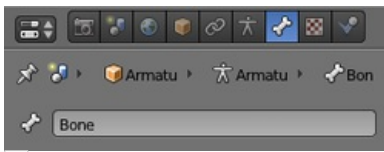
☐ Stick bone display.



☐ Envelope bone display.

Since armatures are made of bones, you'll find more about this when we'll talk about [Armatures Visualization](#).

When the Axes button of the Armature panel is enabled, bones show a local coordinates system at their tip. *The Y axis is always aligned along the bone, oriented from root to tip.* So this is the *roll* axis of the bones.



The Bone context.

Bones properties

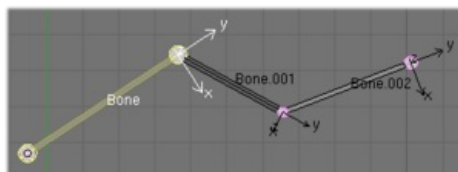
When bones are selected (hence in Edit mode and Pose mode), their properties are shown in the Bone button context of the Properties window.

This shows different panels used to control features of each selected bone, the panels change depending on which mode you're working in.

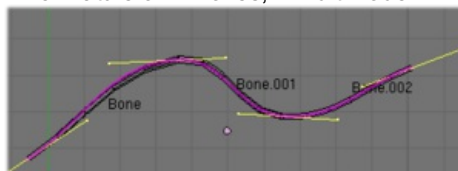
Bones Rigidity

Even though bones are rigid by themselves (i.e. behave as sticks), they are made out of "segments", which are small rigid linked elements that can rotate between each other. By default, each new bone has only one segment, so it cannot "bend" along its curve part: it is a rigid bone.

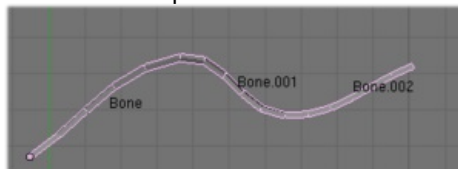
You can see these segments in Object mode and in Pose mode, and only if bones are visualized as B-bones, while in Edit mode bones are drawn as rigid sticks anyway. Note that in the special case of a single bones, you can't see these segments in Object mode, because they're aligned.



An armature of B-Bones, in Edit mode



The B zier curve superposed to the chain, with its handles placed at bones' ends.



The same armature in Object mode

When you connect bones to form a [chain](#), Blender calculates a Bezier curve passing through all the bones' ends, and bones' segments in the chain will bend and roll to follow these invisible curve.

You have no direct access to this curve, you can only control it to some extent using bone properties, as explained in the [editing pages](#).

In An armature of B-Bones in Edit mode we connected 3 bones, each one made of 5 segments. These are B-bones but as you see, in Edit mode they are shown as rigid elements. Look at The same armature in Object mode: now, in Object mode, we can see how the bones' segments smoothly "blend" into each other, even for roll.

Of course a geometry influenced by the chain is smoothly deformed accordingly to the Bezier curve! In fact, smooth bones are an easy way to replace long chains of many small rigid bones posed using IK...

However, if the chain has an influence on objects rather than geometry, the segments orientation is not taken in account (details are explained in the [skinning part](#)).

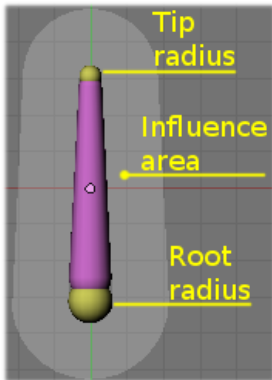
When not visualized as B-Bones, bones are always shown as rigid sticks, *even though the bones segments are still present and effective* (see [skinning to ObData](#)).

This means that even in e.g. Octahedron visualization, if some bones in a chain have several segments, they will nonetheless smoothly deform their geometry...

Bones influence

Basically, a bone controls a geometry when vertices "follow" the bone. To do this, you have to define **how much** a bone influences a certain vertex.

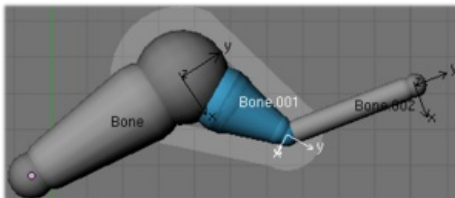
The simplest way is to have each bone affecting those parts of the geometry that are within a given range from it. This is called the *envelope technique*, because each bone can control only the geometry "enveloped" by its own influence area.



A bone in Envelope visualization, in Edit mode.

If a bone is visualized as Envelope, in Edit mode and in Pose mode you can see the area of influence, which depends on:

- the distance property
- the root's radius and the tip's radius.

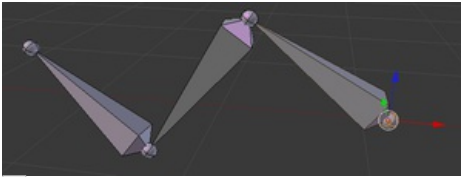


Our armature in Envelope visualization, in Pose mode.

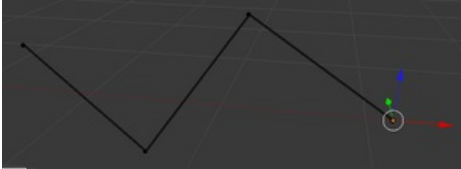
All these influence parameters are further detailed in the [skinning pages](#).

Armature visualization

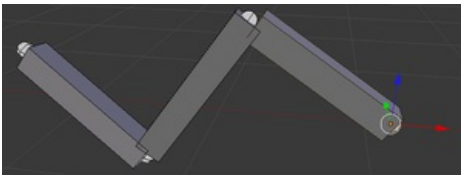
We have 4 basic visualization types of the bones: Octahedral, Stick, B-Bone and Envelope:



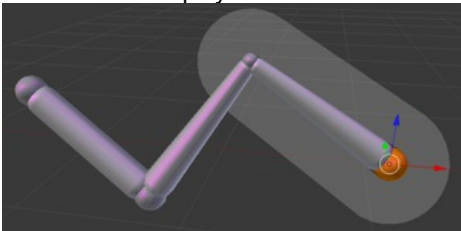
Octahedral bone display.



Stick bone display.



B-Bone bone display.



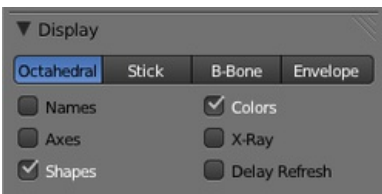
Envelope bone display.

Display Panel

Mode: Object, Edit and Pose modes

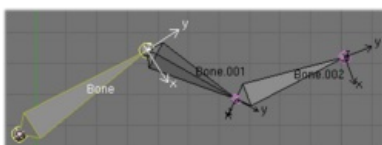
Panel: Display Object Data context

But let's first see some general visualization properties of armatures, found in the Display panel of the Object data context.



The Display panel.

Bone types

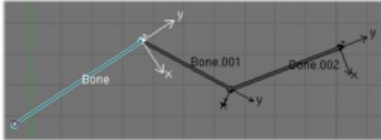


A basic armature in Octahedron visualization, Edit mode.
Note the **40°** rolled `Bone.001` bone.

Octahedral bone

This is the default visualization, well suited for most of editing tasks. It materializes:

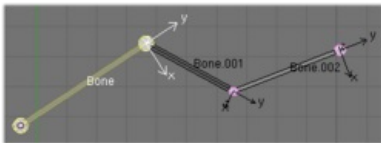
- The bone root (“big” end) and tip (“small” end).
- The bone “size” (its thickness is proportional to its length).
- The bone roll (as it has a square section).



The same armature in Stick visualization, Pose mode.
Note that `Bone.001` roll angle is not visible (except by its XZ axes).

Stick bone

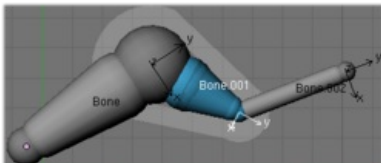
This is the simplest and most non-intrusive visualization. It just materializes bones by sticks of constant (and small) thickness, so it gives you no information about root and tip, nor bone size or roll angle.



The same armature in B-Bone visualization, Edit mode.

B-Bone bone

This visualization shows the curves of “smooth” multi-segmented bones, see the [bone page](#) for details.



The Bone Groups panel.

Envelope bone

This visualization materializes the bone deformation influence. More on this in the [bone page](#).

Attributes

Names

When enabled, the name of each bone is drawn.

Colors

This is only relevant for Pose mode, and is described in details [here](#).

Axes

When enabled, the (local) axes of each bone are drawn (only relevant for Edit and Pose modes).

X-Ray

When enabled, the bones of the armature will always be drawn on top of the solid objects (meshes, surfaces, ...) – i.e. they will always be visible and selectable (this is the same option as the one found in the Display panel of the Object data context. Very useful when not in Wireframe mode).

Shapes

When enabled, the default standard bone shape is replaced, in Object and Pose modes, by the shape of a chosen object (see [below](#) for details).

Delay Refresh

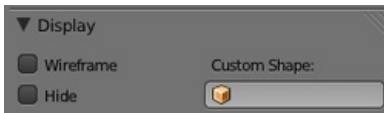
When enabled, it doesn't deform children when manipulating bones on pose mode

Shaped Bones

Mode: Object and Pose modes

Panel: Display panel from Bone context.

Blender allows you to give to each bone of an armature a specific shape (in Object and Pose modes), using another object as “template”. First of all, you have to enable the Shapes button (Armature panel).



The Display panel.

Attributes

Wireframe

When enabled, bone is displayed in wireframe mode regardless of the viewport drawing mode. Useful for non-obstructive custom bone chains.

Hide

Bone is not visible when not in Edit mode.

Custom Shape

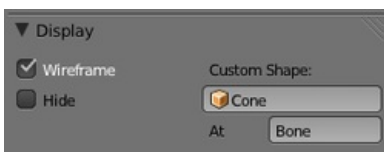
Object that defines the custom shape of the selected bone.

Custom At

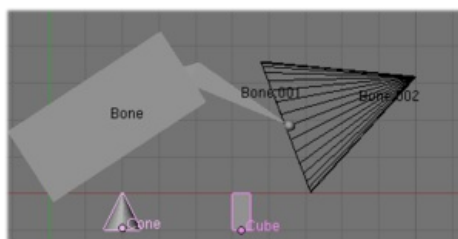
Bone that defines the display transform of this shape bone

To assign a custom shape to a bone, you have to:

- Switch to Pose mode (Ctrl+ Tab).
- Select the relevant bone (RMB click on it).
- Go to the Display panel Custom Shape field and select the 3D object previously created in the scene, in this example we are using a cone and a cube, you can optionally set the At field to another bone.

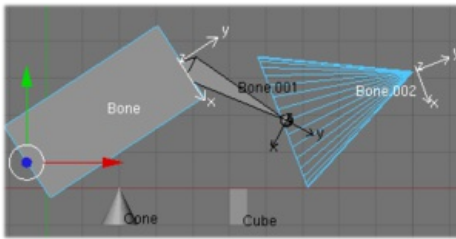


The Display panel.



The armature with shapes assigned to two bones, in Object mode.

Note the centers of the Cone and Cube objects.



The same armature in Pose mode...

Note that:

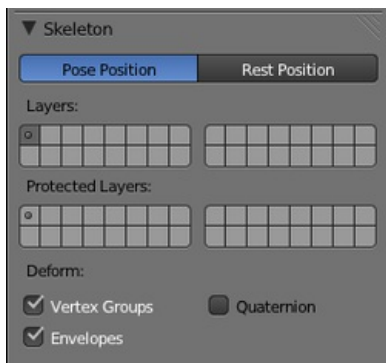
- These shapes will never be rendered – as any bone, they are only visible in 3D views.
- Even if any type of object seems to be accepted by the OB field (meshes, curves, even metas...), only meshes really work – all other types just make the bone invisible, nothing is drawn...
- The center of the shape object will be at the *root of the bone* (see the [bone page](#) for root/tip).
- The object properties of the shape are ignored (i.e. if you make a parallelepiped out of a cube by modifying its dimensions in Object mode, you'll still have a cube shaped bone...).
- The “along bone” axis is the Y one, and the shape object is always scaled so that one Blender Unit stretches along the whole bone length.
- If you need to remove the custom shape of the bone just right click in the Custom Shape field and select Reset to default value in the popup menu.

So to summarize all this, you should use as shape objects meshes, with their center at their lower-Y end, and an overall Y length of **1.0** BU.

Armature Layers

Mode: Object, Edit and Pose modes

Panel: Skeleton panel, Object data context



The Skeleton panel.

Each armature has 32 “Armature layers”, that allow you to organize it by “regrouping” sets of bones in layers, working similar to scene layers (those containing your objects). You can then “move” a bone to a given layer, hide or show one or several layers, etc.


Showing/hiding bone layers

Only bones in active layers will be visible/editable – but they will always be effective (i.e move objects or deform geometry), being in an active layer or not. To (de)activate a layer, you have several options, depending in which mode you are in:

- In all modes, use the row of small buttons at the top of the Display Options group, Armature panel. If you want to enable/disable several layers at once, as usual, hold **⇧ Shift** while clicking...
- In Edit and Pose modes, you can also do this from the 3D Views, either by using the menu (Armature » Switch Armature Layers or Pose » Switch Armature Layers), or the **⇧ ShiftM** shortcut, to display a small pop-up dialog containing the same buttons as described above (here again, you can use **⇧ Shift LMB** clicks to (de)select several layers at once).

Protected Layers

You can lock a given bone layer for all [proxies](#) of your armature, i.e. all bones in this layer won't be editable. To do so, in the Skeleton

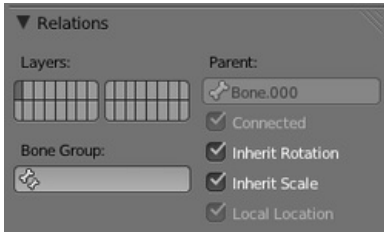
panel, Ctrl LMB  click on the relevant button, the locked layer will be enabled.

Protected layers in proxy are restored to proxy settings on file reload and undo.

Bone Layers



Mode: Object, Edit and Pose modes

Panel: Relations panel Bone context



The Relations panel.

Moving bones between layers

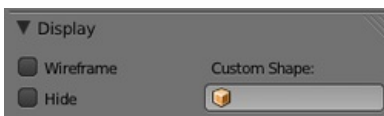
Obviously, you have to be in Edit or Pose modes to move bones between layers – note that as with objects, bones can lay in several layers at once, just use the usual  Shift LMB  clicks... First of all, you have to select the chosen bone(s)!

- In the Button window, use the “layer buttons” of each selected bone “sub-panel” (Armature Bones panel) to control in which layer(s) it lays.
- In the 3D View window, use the menu (Armature » Move Bone To Layer or Pose » Move Bone To Layer) or hit M to show the usual pop-up layers dialog. Note that this way, *you assign the same layers to all selected bones*.

Hiding Bones


Mode: Edit and Pose modes

Panel: Display panel, Bone context



The Display panel.

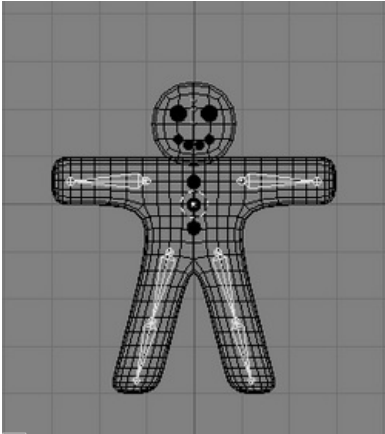
You do not have to use bone layers to show/hide some bones. As with objects, vertices or control points, you can use the H key:

- H will hide the selected bone(s).
-  ShiftH will hide all bones *but the selected one(s)*.
- AltH will show all hidden bones.

You can also use the Hide check button of the Display panel, Bone context).

Note that hidden bones are specific to a mode – i.e. you can hide some bones in Edit mode, they will still be visible in Pose mode, and vice-versa. Hidden bone in Pose mode are also invisible in Object mode. And in Edit mode, the bone to hide must be fully selected, not just his root or tip...

Armature Structure



The very basic armature of the [Gingerbread Man tutorial](#).

As said, armatures mimic real skeletons. They are made out of bones, which are (by default) rigid elements. But you have more possibilities than with real skeletons... In addition to the “natural” rotation of bones, you can also translate and even scale them! And your bones do not have to be connected to each other, they can be completely free if you want. However, the most natural and useful setups imply that some bones are related to each others, forming so-called “chains of bones”, some sort of “limbs” in your armature, as detailed [below](#).

Chains of Bones



An armature with two chains of bones.

The bones inside an armature can be completely independent from each other (i.e. the modification of one do not affect the others)... but this is not often a useful setup! To create something like a leg, you want that all bones “after” the thigh one move “with” it, as if they were parented. Well, this is exactly what happens in armatures – by “parenting” bones to each other, you create such “limbs”, called in Blender “chains of bones”. These chains can of course be ramified, e.g. for the five fingers attached to a single “hand” bone...

Bones are chained by linking the tip of the parent to the root of the child. Root and tip can be *connected*, i.e. they are always exactly at the same point, or they can be *free*, like in a standard parent relationship.

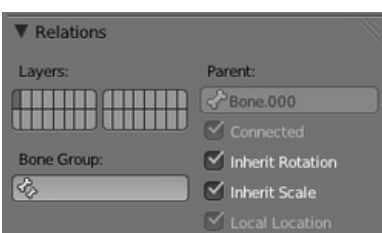
A same bone can be the parent of several children, and hence be part of several chains at the same time.

The bone at the beginning of a chain is called its *root bone*, and the last bone of a chain is the *tip bone* (don’t confuse them with bones’ ends names...).

Chains of bones are a particularly important topic in [posing](#) (especially with the standard *forward kinematics* versus “automatic” *inverse kinematics* posing techniques...). You create/edit them in Edit mode, but except for connected bones, their relationships have no effect on bone transformations in this mode (i.e. transforming a parent bone won’t affect its children...).

Editing Bones Relationships

This is detailed in the [editing pages](#), but let’s have here a quick look at this important feature.



The Armature Bones panel with two

bones selected, and their Child of settings highlighted.

The easiest way to manage bones relationships is to use the Relations panel Bone context:

- First, [select](#) the bones you want to edit (order does not matter here).
- To *parent* a bone to another one, select the name of this parent in its drop-down Parent list.
- To *unparent* a bone, just select the void entry in the same Parent list.
- To *connect* a bone to its parent, enable its small Con button.
- To *disconnect* a bone, disable its Con button.

Selecting elements of an armature

Mode: Edit mode

Panel: Bone panel

You can select (and edit) bones of armatures in Edit mode and in Pose mode.
In this page, we will see how to select bones in Edit mode, but selecting in Pose mode is very similar (the few specificities will be detailed in the [posing part](#)).

In Edit mode, as edges in meshes, you have two ways to select whole bones:

- directly selecting the bone, or
- selecting both of its ends

exactly like [vertices/edges selection](#) in meshes.

This is an important point to understand, because selecting bones' ends only might lead to non-obvious behavior, in respect to which bone you actually select, see the .

Also note that unlike the mesh draw type, the armature draw type has no effect on the selection behavior: that is, you select a bone's tip always the same way, whichever bone visualization you choose.

Selecting bones ends

To select bones ends you have the standard selection methods.

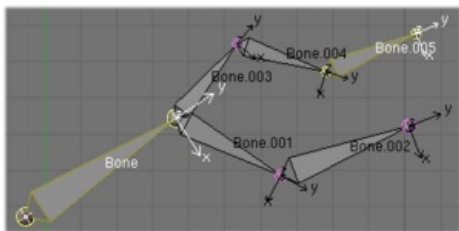
action	shortcut	menu	mouse
Select a bone's end			RMB click on it
Add or Remove from the current selection			⇧ Shift RMB
(De)select the ends of all bones	A	Select » Select/Deselect All	
Invert the current selection	Ctrl	Select » Inverse	
Box selection tool ON	B	Select » Border Select	
Box selection			click and drag LMB the box around the ends you want to add to the current selection click and drag LMB to remove from the current selection release LMB to validate hit Esc or click RMB to cancel
Box selection tool OFF	B or Esc		RMB
Lasso selection			click and drag Ctrl LMB the lasso around the ends you want to add to the current selection click and drag Ctrl⇧ Shift LMB to remove from the current selection release LMB to validate hit Esc or click RMB to cancel

Inverse selection

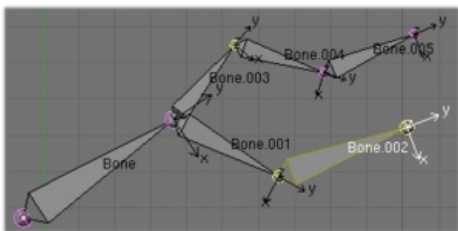
As said above, you have to remember that these selection tools are for bones ends only: if not, you might be confused from the results.

For example, the Inverse selection option (Ctrl) invert the selection of bones' ends, not of bones (see *Inverse selection*).

Inverse selection



Two bones selected.




The result of the inverse selection (Ctrl): the bones' ends selection has been inverted, and not the bones selection...

Selecting connected bones ends


Another example is: when you select the root of a bone connected to its parent, you also implicitly select the tip of this parent (and vice-versa).

Remember: when selecting bones ends, the tip of the parent bone is the “same thing” as the root of its children bones.

Selecting Bones

By RMB -clicking on a bone's body, you will select it (and hence you will implicitly select its root and tip).

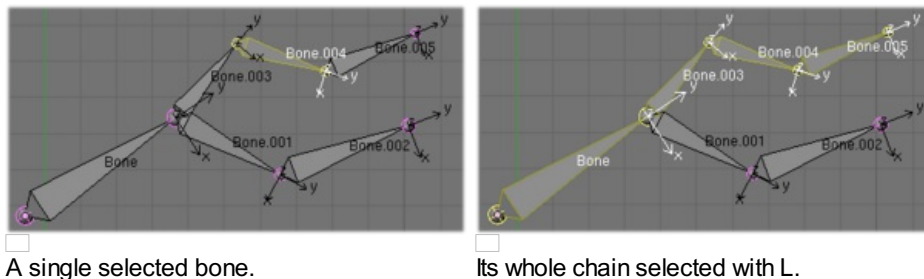
To each selected bone corresponds a sub-panel in the Armature Bones panel (Editing context, F9). These sub-panels contain settings for some of the bones' properties (regarding e.g. relationships between bones, bones' influence on deformed geometry, etc.), as we will see later.

Using ⇧ Shift RMB , you can add to/remove from the selection.

You also have some **advanced selection** options, based on their relations.

You can select at once all the bones in the chain which the active (lastly selected) bone belongs to by using the *linked selection* tool, L.

Linked bones selection



You can deselect the active bone and select its immediate parent or one of its children using respectively Select » Select Parent (⇧) or Select » Select Child (⇩). If you prefer to keep the active bone in the selection, use Select » Extend Select Parent ($\text{Ctrl}[\text{⇧}]$) or Select » Extend Select Child ($\text{Ctrl}[\text{⇩}]$).

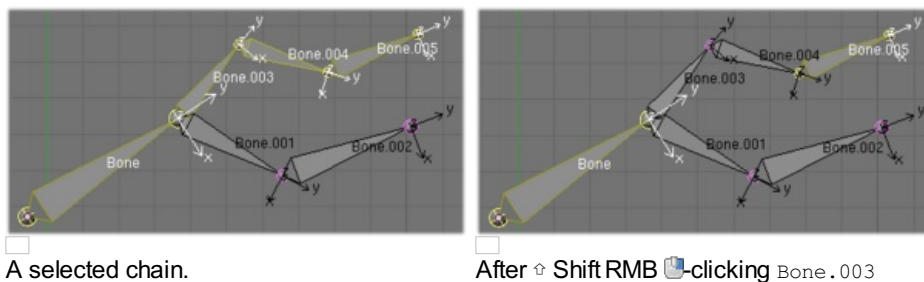
Deselecting connected bones

There is a subtlety regarding connected bones.

When you have several connected bones selected, if you deselect one bone, *you will in fact deselect its tip, but not its root if it is also the tip of another selected bone*

Look at *Bone deselection in a selected chain*.

Bone deselection in a selected chain



After ⇧ Shift RMB -clicking Bone.003:

- Bone.003's tip has been deselected and hence also Bone.004's root has been
- Bone.003's root has not been deselected because Bone is Bone.003's parent and is still selected

Armature Editing

Mode: Edit mode

Hotkey: ⇐ Tab

As with any other object, you edit your armature in Edit mode (⇐ Tab).

Editing an armature means two main domains of action:

- [Editing the bones](#) – i.e. adding/inserting/deleting/extruding/sub-dividing/joining them...
- [Editing the bones' properties](#) – this includes key features, like transform properties (i.e. grab, scale, etc...) and relationships between bones (parenting and connecting), as well as bones' names, influence, behavior in Pose mode, etc.

These are standard editing methods, quite similar for example to [meshes](#) editing. Blender also features a more advanced “armature sketching” tool, called [Etch-a-Ton](#). The same tool might also be used in [templating](#), i.e. using another armature as template for the current one...



One important thing to understand about armature editing is that you **edit the rest position of your armature**, i.e. its “default state”. An armature in its *rest position* has all bones with no rotation and scaled to **1.0** in their own local space.

The different [poses](#) you might create afterwards are based on this rest position – so if you modify it in Edit mode, all the poses already existing will also be modified. Thus you should in general be sure that your armature is definitive before starting to [skin](#) and [pose](#) it!



Please note that some tools work on bones' ends, while others work on bones themselves. Be careful not to get confused.

Editing Bones


Mode: Edit mode

Hotkey: ⇧ Tab

You'll learn here how to [add](#), [delete](#) or [subdivide](#) bones. We will also see how to [prevent any bone transformation](#) in Edit mode, and the option that features an [automatic mirroring](#) of editing actions along the X axis.

Adding Bones

To add bones to your armature, you have more or less the same options as when editing meshes:

- Add menu,
- extrusion,
- Ctrl LMB  clicks,
- fill between joints,
- duplication.

Add Menu

Mode: Edit mode

Hotkey: ⇧ ShiftA

In the 3D view, ⇧ ShiftA » Bone to add a new bone to your armature.

This bone will be:

- of one Blender Unit of length,
- oriented towards the positive Y axis of the view,
- with its root placed at the 3D cursor position
- with no relationship with any other bone of the armature.

Extrusion

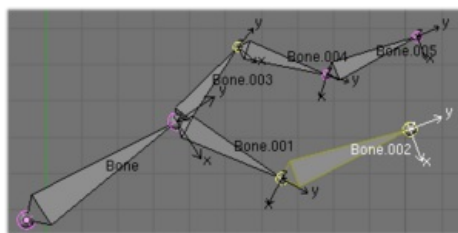
Mode: Edit mode

Hotkey: E, ⇧ ShiftE

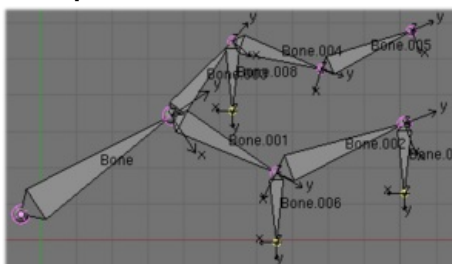
Menu: Armature » Extrude

When you press the E key, for each selected tip (either explicitly or implicitly), a new bone is created. This bone will be the child of “its” tip owner, and connected to it. As usual, once extrusion is done, only the new bones’ tips are selected, and in grab mode, so you can place them to your liking. See (*Extrusion example*).

Extrusion example



An armature with three selected tips.

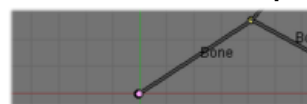


The three extruded bones.

You also can use the rotating/scaling extrusions, as explained for meshes [here](#), by hitting respectively ER and ES – as well as “[locked](#)” extrusion along a global or local axis.

Bones have an extra “mirror extruding” tool, called by ⇧ ShiftE. By default, it behaves exactly as the standard extrusion. But once you have enabled the X-Axis mirror editing option (see [below](#)), each extruded tip will produce *two new bones*, having the same name except for a leading “_L/_R” code (for left/right, see the [next page](#)). The “_L” bone behaves a the single one produced by the default extrusion – you can grab/rotate/scale it exactly the same way. The “_R” bone is its mirror counterpart (along the armature’s local X axis), see (*Mirror extrusion example*).

Mirror extrusion example



A single selected bone’s tip.



Note that exactly as in mesh editing, if you press Esc right after you have pressed E, the extruded bones will be there but their length will be zero, so very likely this will give you some headache. If you realize the problem immediately, you can undo by pressing CtrlZ.



The two mirror-extruded bones.

In case you wonder, you cannot just press X to solve this as you do in mesh editing, because extrusion selects the newly created tips, and as explained below the delete command ignores bones' ends. To get rid of these extruded bones without undoing, you would have to move the tips, then select the bones and [delete](#) them.


Mouse Clicks

Mode: Edit mode

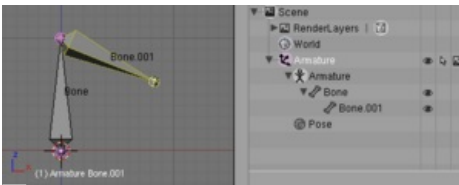
Hotkey: Ctrl LMB 

If at least one bone is selected, Ctrl LMB -clicking adds a new bone.

About the new bone's tip:

- after you Ctrl LMB -clicked it becomes the active element in the armature,
- it appears to be right where you clicked, but...
- ...(as in mesh editing) it will be on the plane parallel to the view and passing through the 3D cursor.

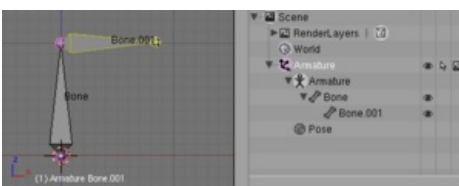
The position of the root and the parenting of the new bone depends on the active element:



Ctrl-clicking when the active element is a **bone**

If the active element is a **bone**

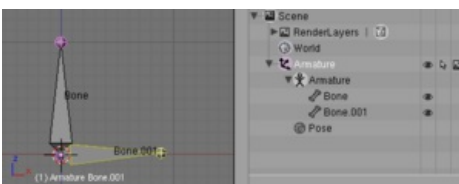
- the new bone's root is placed on the active bone's tip
- the new bone is parented and connected to the active bone (check the outliner in *Ctrl-clicking when the active element is a bone*).



Ctrl-clicking when the active element is a **tip**

If the active element is a **tip**:

- the new bone's root is placed on the active tip
- the new bone is parented and connected to the bone owning the active tip (check the outliner in *Ctrl-clicking when the active element is a tip*).

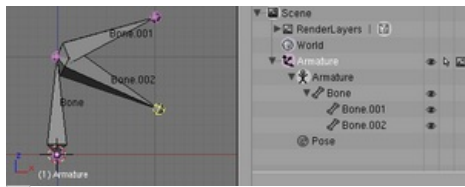


Ctrl-clicking when the active element is a **disconnected root**

If the active element is a **disconnected root**:

- the new bone's root is placed on the active root
- the new bone is **NOT** parented to the bone owning the active root (check the outliner in *Ctrl-clicking when the active element is a disconnected root*).

And hence the new bone will **not** be connected to any bone.



Ctrl-clicking when the active element is a **connected root**

If the active element is a **connected root**:

- the new bone's root is placed on the active root
- the new bone **IS** parented and connected to the parent of the bone owning the active root (check the outliner in *Ctrl-clicking when the active element is a connected root*).

This should be obvious because if the active element is a connected root then the active element is also the tip of the parent bone, so it is the same as the second case.

As the tip of the new bone becomes the active element, you can repeat these ctrl-clicks several time, to recursively add several bones to the end of the same chain.

Fill between joints

Mode: Edit mode

Hotkey: F

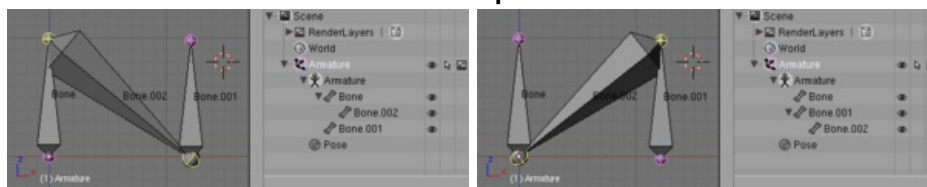
Menu: Armature » Fill Between Joints

The main use of this tool is to create one bone between two selected ends by pressing F, similarly to as in mesh editing we do “create edges/faces”.

If you have one root and one tip selected, the new bone:

- will have the root placed on the selected tip
- will have the tip placed on the selected root
- will be parented and connected to the bone owning the selected tip

Fill between a tip and a root



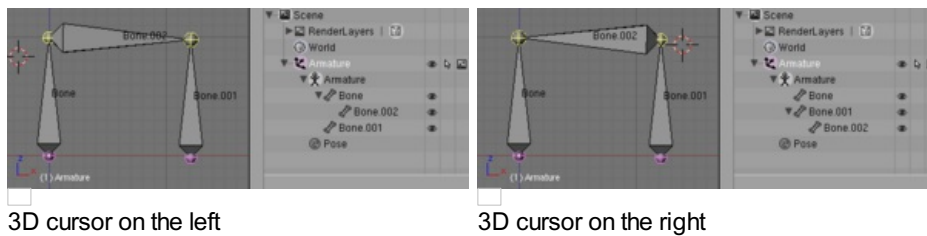
Active tip on the left

Active tip on the right

If you have two tips selected, the new bone:

- will have the root placed on the selected tip closest to the 3D cursor
- will have the tip placed on the other selected tip
- will be parented and connected to the bone owning the tip used as the new bone's root

Fill between tips



3D cursor on the left

3D cursor on the right

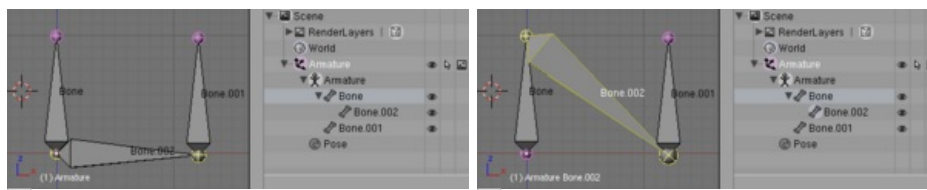
If you have two roots selected, you will face a small problem due to the event system in Blender not updating the interface in real time.

When clicking F, similarly to the previous case, you will see a new bone:

- with the root placed on the selected root closest to the 3D cursor
- with the tip placed on the other selected root
- parented and connected to the bone owning the root used as the new bone's root

If you try to move the new bone, Blender will update the interface and you will see that the new bone's root moves to the tip of the parent bone.

Fill between roots

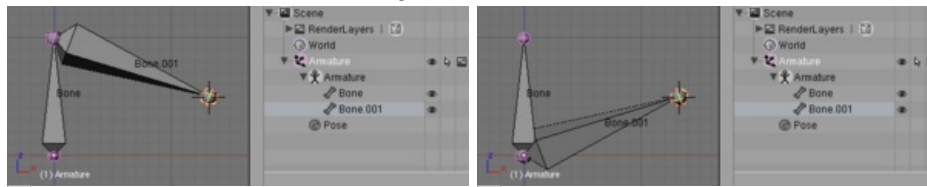


Before UI update (3D cursor on the left)

After UI update, correct visualization

Clicking F with only one bone end selected will create a bone from the selected end to the 3D cursor position, and it won't parent it to any bone in the armature.

Fill with only one bone end selected



Fill with only one tip selected

Fill with only one root selected

You will get an error when:

- trying to fill two ends of the same bone, or
- trying to fill more than two bone ends.

Duplication

Mode: Edit mode

Hotkey: **⇧** ShiftD

Menu: Armature » Duplicate



This tool works on selected bones: selected ends are ignored.

As in mesh editing, by pressing **⇧** ShiftD:

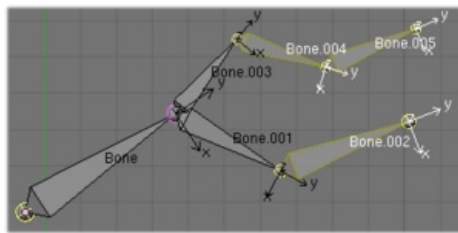
- the selected bones will be duplicated,
- the duplicates become the selected elements and they are placed in grab mode, so you can move them wherever you like.

If you select part of a chain, by duplicating it you'll get a copy of the selected chain, so the copied bones are interconnected exactly as

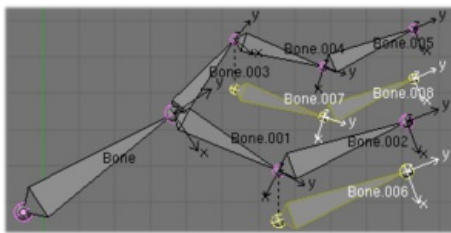
the original ones.

The duplicate of a bone which is parented to another bone will also be parented to the same bone, even if the root bone is not selected for the duplication. Be aware, though, that if a bone is parented **and connected** to an unselected bone, its copy will be parented **but not connected** to the unselected bone (see *Duplication example*).

Duplication example



An armature with three selected bones and a selected single root.



The three duplicated bones. Note that the selected chain is preserved in the copy, and that Bone.006 (resp. Bone.007) is parented but not connected to Bone.001 (resp. Bone.003), as materialized by the black dashed lines.

Deleting Bones

You have two ways to remove bones from an armature: the standard deletion, and merging several bones in one.

Standard deletion

Mode: Edit mode

Hotkey: X

Menu: Armature » Delete



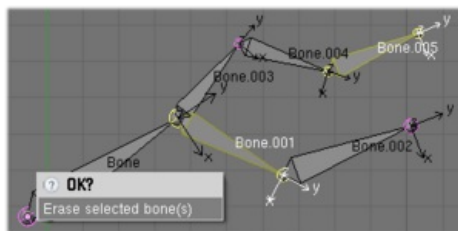
This tool works on selected bones: selected ends are ignored.

To delete a bone, you can:

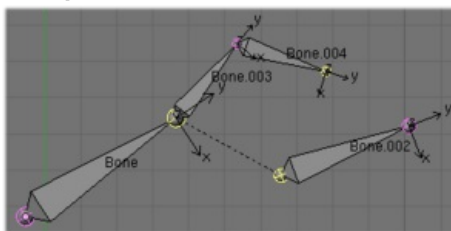
- press the standard X key and confirm, or
- use the menu Armature » Delete and confirm.

If you delete a bone in a chain, its child(ren) will be automatically re-parented to its own parent, **but not connected**, to avoid deforming the whole armature.

Deletion example



An armature with two selected bones, just before deletion.



The two bones have been deleted. Note that Bone.002, previously connected to the deleted Bone.001, is now parented but not connected to Bone.003.

Merge

Mode: Edit mode

Hotkey: AltM

Menu: Armature » Merge

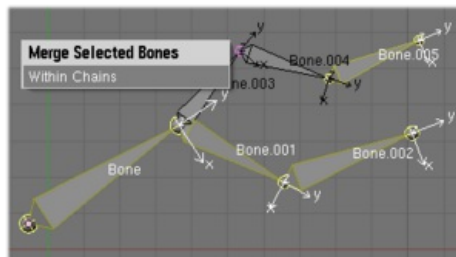
You can merge together several selected bones, *as long as they form a chain*. Each sub-chain formed by the selected bones will give one bone, whose root will be the root of the root bone, and whose tip will be the tip of the tip bone.

Confirm by clicking on Within Chains in the Merge Selected Bones pop-up.

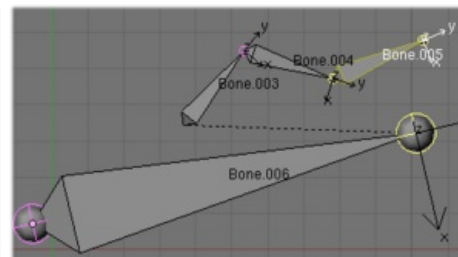
If another (non-selected) chain originates from inside of the merged chain of bones, it will be parented to the resultant merged bone. If they were connected, it will be connected to the new bone.

Here's a strange subtlety (see *Merge example*): even though connected (the root bone of the unmerged chain has no root sphere), the bones are not visually connected – this will be done as soon as you edit one bone, differently depending in which chain is the edited bone (see the example to understand this better).

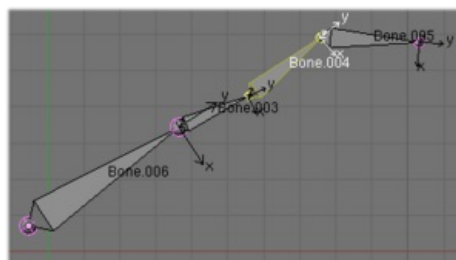
Merge example



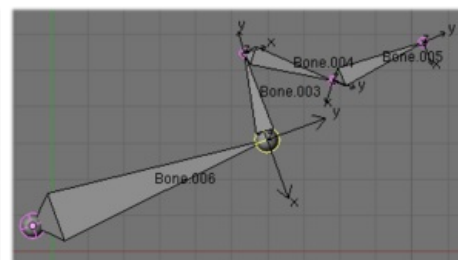
An armature with a selected chain, and a single selected bone, just before merging.



Bones Bone, Bone.001 and Bone.002 have been merged in Bone.006, whereas Bone.005 wasn't modified. Note Bone.003, connected to Bone.006 but not yet "really" connected.



Bone.004 has been rotated, and hence the tip of Bone.006 was moved to the root of Bone.003.



The tip of Bone.006 has been translated, and hence the root of Bone.003 was moved to the tip of Bone.006...

Subdividing Bones

Mode: Edit mode

Hotkey: W1, W2

Menu: Armature » Subdivide, Armature » Subdivide Multi

You can subdivide bones, to get two or more where there was just one bone. The tool will subdivide all selected bones, preserving the existing relationships: the bones created from a subdivision always form a connected chain of bones.

To create two bones out of each selected bone:

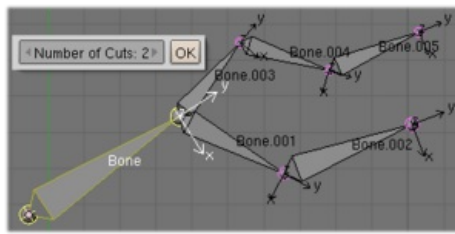
- press W » Subdivide, same as W1, or
- select Armature » Subdivide from the header menu

To create an arbitrary number of bones from each selected bone:

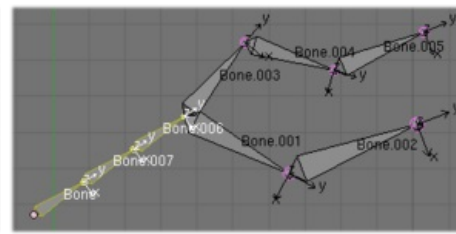
- press W » Subdivide Multi, same as W2, or
- select Armature » Subdivide Multi from the header menu, and

Then specify the number of cuts you want in the popup. As in mesh editing, if you set n cuts, you'll get $n+1$ bones for each selected bone.

Subdivision example



An armature with one selected bone, just before multi-subdivision.



The selected bone has been “cut” two times, giving three sub-bones.

Locking Bones

You can prevent a bone from being transformed in Edit mode in several ways:

- The active bone can be locked clicking on Lock in the Transform Properties panel (N in a 3D view);
- all bones can be locked clicking on the Lock button of their sub-panels in the Armature Bones panel;
- press **⇧ ShiftW** » Toggle Settings » Locked
- select Armature » Bone Settings » Toggle a Setting).

If the root of a locked bone is connected to the tip of an unlocked bone, it won't be locked, i.e. you will be able to move it to your liking. This means that in a chain of connected bones, when you lock one bone, you only really lock its tip. With unconnected bones, the locking is effective on both ends of the bone.

X-Axis Mirror Editing

Another very useful tool is the X-Axis Mirror editing option (Tool panel > Armature Options, while Armature is selected in Edit Mode), working a bit like the same [mesh editing tool](#). When you have pairs of bones of the same name with just a different “side suffix” (e.g. `.R.L`, or `_right/_left...`), once this option is enabled, each time you transform (move/rotate/scale...) a bone, its “other side” counterpart will be transformed accordingly, through a *symmetry along the armature local X axis*. As most rigs have at least one axis of symmetry (animals, humans, ...), it's an easy way to spare you half of the editing work! See also [next page](#) for more on naming bones.

Separating Bones in a new Armature

You can, as with meshes, separate the selected bones in a new armature object (Armature » Separate, **CtrlAltP**) – and of course, in Object mode, you can join all selected armatures in one (Object » Join Objects, **CtrlJ**).

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Editing Bone Properties

You will learn in this page how to edit/control most of the bone's properties – you should have read the [previous page](#) first! We will see how to [manage the bones relationships](#), [rename them](#), etc.

Transforming Bones

We won't detail here the various transformations of bones, nor things like axis locking, pivot points, and so on, as they are common to most object editing, and already described [here](#) (note however that some options, like snapping, do not seem to work, even though they are available...). The same goes for mirroring, as it's nearly the same as with [mesh editing](#). Just keep in mind that bones' roots and tips behave more or less like meshes' vertices, and bones themselves, as meshes' edges...

As you know, bones can have two types of relationships: they can be parented, and in addition connected. Parented bones behave in Edit mode exactly as if they had no relations – you can grab, rotate, scale, etc., a parent bone without affecting its descendants... However, connected bones must always have parent's tips connected to child's roots, so by transforming a bone, you will affect all its connected parent/children/siblings.



The Transform Properties panel for armatures in Edit mode.

Finally, you can edit in the Transform Properties panel (N) the positions and radius of both ends of the active selected bone, as well as its [roll rotation](#).

Radius and Scaling in Envelope Visualization

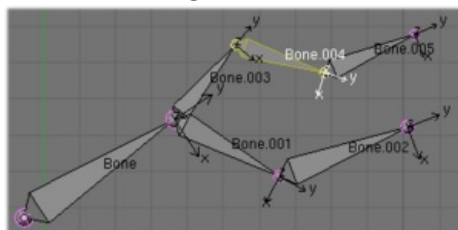
Mode: Edit mode, Envelope visualization

Hotkey: S

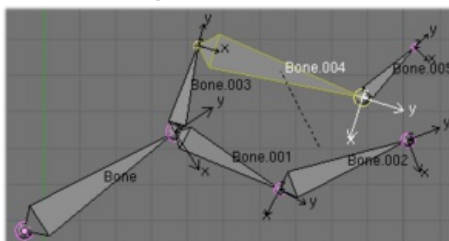
Menu: Armature » Transform » Scale

While scaling in Octahedron, Stick or B-Bone visualizations behave as expected, it has a different effect in Envelope visualization: it will scale the radius of the selected bones's ends, see the [skinning part](#). As you control only one value (the radius), there is no axis locking here. And as usual, with connected bones, you scale at the same time the radius of the parent's tip and of the children's roots.

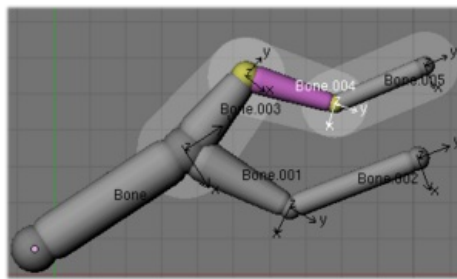
Scaling of a bone in Octahedron and Envelope visualizations.



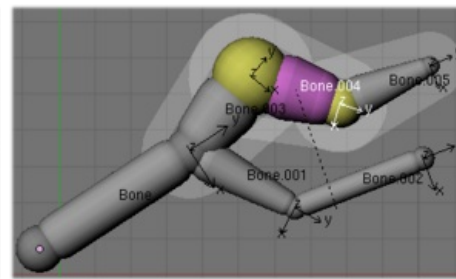
A single selected bone...



...Scaled in Octahedron visualization.



☐ A single selected bone...



☐ ...Scaled in Envelope visualization – its length remains the same, but its ends' radius are bigger.

About the ends radius, note that Blender automatically adjust them when you resize a bone (either by directly scaling it, or by moving one of its ends), proportionally to the size modification... So you should edit these properties, if needed, only after all bones have been well placed!

ScaleB and Envelope

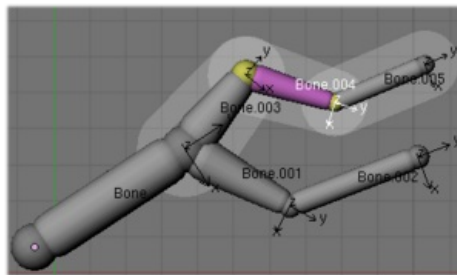
Mode: Edit mode

Hotkey: CtrlAltS

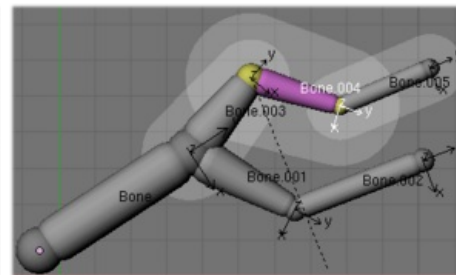
CtrlAltS activates one transform tool specific to armatures, and which have a different behavior depending on the active visualization.

In Envelope visualization, it allows you to edit the influence of the selected bones (their Dist property, see the [skinning part](#)) – as with the “standard” scaling with this visualization, this is a one-value property, so there is no axis locking and such.

Envelope scaling example



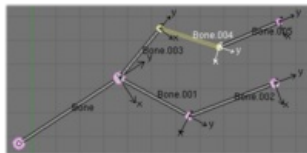
☐ A single bone selected in Envelope visualization.



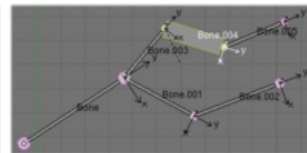
☐ Its envelope scaled with CtrlAltS.

In the other visualizations, it allows you to edit the “bone size”. This seems to only have a visible effect in B-Bone visualization, but is available also with Octahedron and Stick... This tool has here another specificity: while for any other transform tools, the “local axes” are the object’s ones, here they are the bone’s ones (this means that when you lock on a local axis, by pressing twice the relevant key, this is the selected bone’s local axis, not the armature object’s one). By the way, do not try to lock on a local axis with this tool if you have more than one bone selected: it’s a very efficient way to crash Blender!

“Bone size” scaling example



☐ A single “default size” bone selected in B-Bone visualization.



☐ Its size scaled with CtrlAltS.



☐ The same armature in Object mode and B-Bone visualization, with Bone.004's size scaled up.

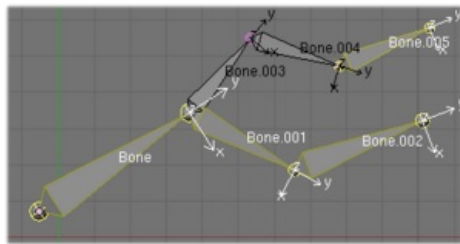
Bone Direction

Mode: Edit mode

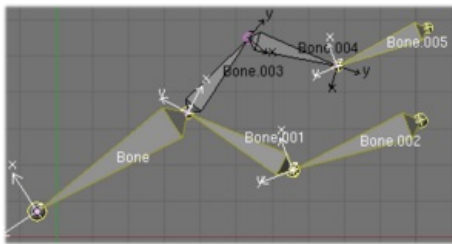
Hotkey: W3

Menu: Specials » Switch Direction

This tool is not available from the Armature menu, but only from the Specials pop-up one (W). It allows you to switch the direction of the selected bones, i.e. that their root will become there tip, and vice versa. *Switching the direction of a bone will generally break the chain(s) it belongs to.* However, if you switch a whole (part of a) chain, the switched bones will still be parented/connected, but in “reversed order”. See (Switching example).



An armature with one selected bone, and one selected chain of three bones, just before switching.



The selected bones have been switched. Bone.005 is no more connected nor parented to anything. The chain of switched bones still exists, but reversed (Bone.002 is now its root, and Bone.001 its tip). Bone.003 is now also a free bone.

Switching example.

Bone Roll

Mode: Edit mode

Hotkey: CtrlR, CtrlN

Menu: Armature » Bone Roll » ...

In Edit mode, you have options dedicated to the control of the bone roll rotation (i.e. the rotation around the Y axis of the bone). Each time you add a new bone, its roll is so that its Z axis is as much perpendicular to the current 3D view as possible. And each time you transform a bone, Blender tries to determine its best roll...

But this might lead to an unclear armature, with bones rolled in all angles... nasty! To address this problem, you have three options:

- Armature » Bone Roll » Set Roll (CtrlR) will start a roll-specific rotation, which behaves like any other transform operations (i.e. move the mouse and LMB click to validate, or type a numeric value and hit enter – or RMB click or hit Esc to cancel everything).
- Armature » Bone Roll » Clear Roll (Z-Axis Up) (or CtrlN1 » Recalculate Bone Roll Angles » Clear Roll (Z-Axis Up)) will reset the selected bone roll so that their Z axis is as much as possible aligned with the global Z axis.
- Armature » Bone Roll » Roll to Cursor (or CtrlN2 » Recalculate Bone Roll Angles » Align Z-Axis to 3D-Cursor) will set the selected bone roll so that their Z axis is as much as possible pointed to the 3D cursor.

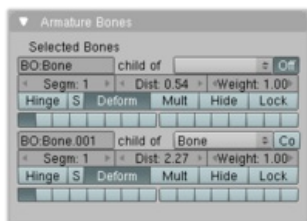
Properties

Mode: Edit mode

Panel: Armature Bones (Editing context, F9)

Hotkey: ⇧ ShiftW, Ctrl⇧ ShiftW, AltW

Menu: Armature » Bone Settings » ...



The Armature Bones panel in Edit mode.

Most bones' properties (excepted the transform ones) are regrouped in each bone's sub-panel, in the Armature Bones panel (Editing context, F9). Let's detail them.

Note that some of them are also available in the 3D views, through the three pop-up menus Toggle Setting (⇧ ShiftW or Armature » Bone Settings » Toggle a Setting), Enable Setting (Ctrl⇧ ShiftW or Armature » Bone Settings » Enable a Setting), and Disable Setting (AltW or Armature » Bone Settings » Disable a Setting) – all three have the same entries, their respective effect should be obvious...

BO

The bone name field, see [below](#).

child of

These two settings control the bone relationship, as detailed [below](#).

Segm

This setting control the number of segments of bones, see [below](#).

Dist, Weight, Deform (also ⇧ ShiftW » Deform & co), Mult (also ⇧ ShiftW » Mult VG & co)

These settings control how the bone influence its geometry – along with the bones' ends radius. This will be detailed in the [skinning part](#).

Hinge (also ⇧ ShiftW » Hinge & co), S (also ⇧ ShiftW » No Scale & co)

These settings affect the behavior of children bones while transforming their parent in Pose mode, so this will be detailed in the [posing part](#)!

Hide

This will hide the bone (same as hitting H in the 3D views, see [this page](#)).

Lock (also ⇧ ShiftW » Locked & co)

This will prevent all editing of the bone in Edit mode, see the [previous page](#).

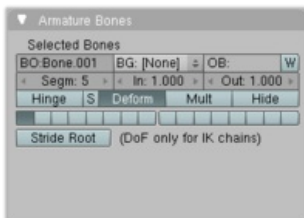
Layers button

These small buttons allow you to control to which bone layer this bone belongs to, see [this page](#).

Bone Rigidity Settings

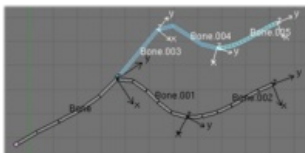
Mode: Edit and Pose modes

Panel: Armature Bones (Editing context, F9)



The Armature Bones panel in Pose mode.

Even though you have the Segm setting available in Edit mode (bones sub-panel, in the Armature Bones panel), you should switch to the Pose mode (Ctrl⇧ Tab) to edit these “smooth” bones' properties – one explanation to this strange need is that in Edit mode, even in B-Bone visualization, bones are drawn as sticks, so you can't visualize the effects of these settings...



An armature in Pose mode, B-Bone visualization:

Bone.003 has one segment,

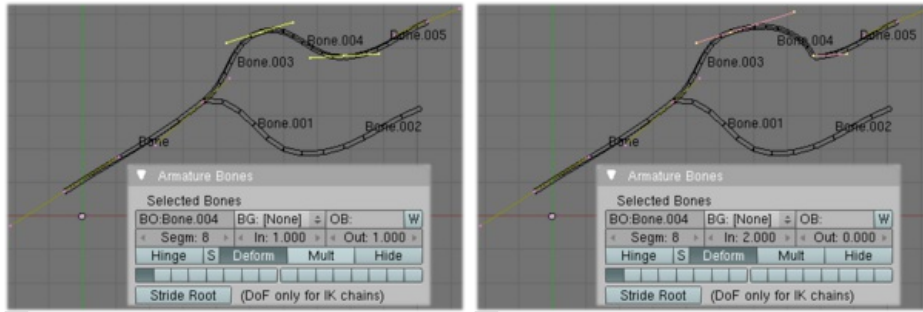
Bone.004 has four, and

Bone.005 has sixteen...

We saw in [this page](#) that bones are made of small rigid segments mapped to a “virtual” Bézier curve. The Segm numeric field allows you to set the number of segments inside a given bone – by default, it is **1**, which gives a standard rigid bone! The higher this setting (max **32**), the smoother the bone, but the heavier the pose calculations...

Each bones' end is a curve “auto” handle. You can't control their direction, but you can affect their “length” using the In and Out numeric fields, respectively controlling the “root handle” and “tip handle” of the bone. These values are proportional to the default length, which of course automatically varies depending on bone length, angle with previous/next bones in the chain, and so on.

Bone In/Out settings example, with a materialized Bézier curve.



Look at Bone.004: it has the default In and Out values (1.0).

Bone.004 with In at 2.0, and Out at 0.0.

Chain Editing

Mode: Edit mode

Panel: Armature Bones (Editing context, F9)

Hotkey: CtrlP, AltP

Menu: Armature » Parent » ...

You can edit the relationships between bones (and hence create/modify the chains of bones) both from the 3D views and the Buttons window. Whatever method you prefer, it's always a matter of deciding, for each bone, if it has to be parented to another one, and if so, if it should be connected to it.

To parent and/or connect bones, you can:

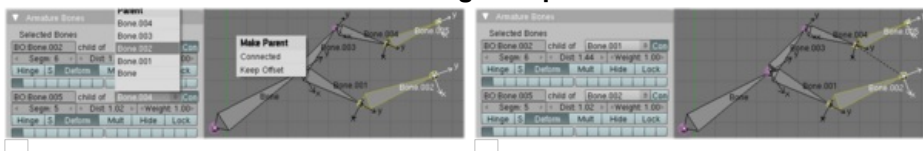
- In a 3D view, select the bone and *then* its future parent, and hit CtrlP (or Armature » Parent » Make Parent...). In the small Make Parent menu that pops-up, choose Connected if you want the child to be connected to its parent, else click on Keep Offset. If you have selected more than two bones, they will all be parented to the last selected one. If you only select one already parented bone, or all selected bones are already parented to the last selected one, your only choice is to connect them, if not already done. If you select only one non-parented bone, you'll get the Need selected bone(s) error message...

With this method, the newly children bones won't be scaled nor rotated – they will just be translated if you chose to connect them to their parent's tip.

- In the Buttons window, Armature Bones panel, for each selected bone, you can select its parent in the Parent drop-down list to the upper right corner of its sub-panel. If you want them to be connected, just enable the little Con button to the right of the list.

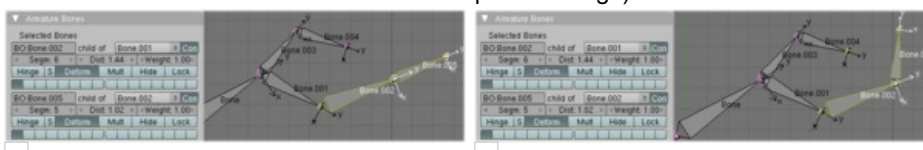
With this method, the tip of the child bone will never been translated – so if Con is enabled, the child bone will be completely transformed by the operation.

Parenting example.



The starting armature, with Bone.005 not parented and connected to Bone.004.

Bone.005 re-parented to Bone.002, but not connected to it (same result, using either CtrlP2 in 3D view, or the Armature Bones panel settings).



Bone.005 parented and connected to Bone.002, using CtrlP1 in 3D view.

Bone.005 parented and connected to Bone.002, using the Parent drop-down list of Bone.005 sub-panel.

To disconnect and/or free bones, you can:

- In a 3D view, select the desired bones, and hit AltP (or Armature » Parent » Clear Parent...). In the small Clear Parent menu that

pops-up, choose Clear Parent to completely free all selected bones, or Disconnect Bone if you just want to break their connections.

- In the Buttons window, Armature Bones panel, for each selected bone, you can select no parent in the Parent drop-down list of its sub-panel, to free it completely. If you just want to disconnect it from its parent, disable the Con button.

Note that relationships with non-selected children are never modified.

Naming Bones

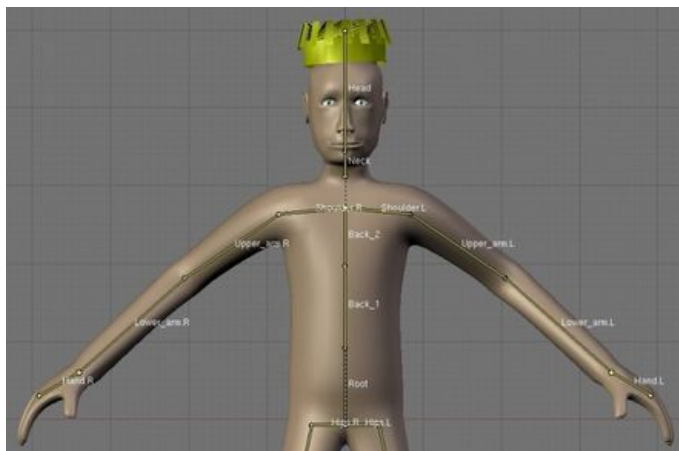
Mode: Edit mode

Panel: Armature Bones (Editing context, F9), Transform Properties (3D views, N)

You can rename your bones, either using the Bone field of the Transform Properties panel in the 3D views, for the active bone (N), or using the BO field in each bone sub-panel of the Armature Bones panel (Editing context, F9).

Blender also proposes you some tools that take advantage of bones named in a left/right symmetry fashion, and others that automatically name the bones of an armature. Let's see this in details.

Naming Conventions



An example of left/right bone naming in a simple rig.

Naming conventions in Blender are not only useful for you to find the right bone, but also to tell Blender when any two of them are counterparts.

In case your armature can be mirrored in half (i.e. it's bilaterally symmetrical), it's worthwhile to stick to a left/right naming convention. This will enable you to use some tools that will probably save you time and effort (like the X-Axis Mirror editing tool we saw above...).

- First you should give your bones meaningful base-names. Like leg, arm, finger, back, foot, etc.
- If you have a bone that has a copy on the other side (a pair), like an arm, give them one of the following separators:
 - Left/right separators can be either the second position (`L_calfbone`) or last-but-one (`calfbone.R`)
 - If there is a lower or upper case L, R, left or right, Blender handles the counter part correctly. See below for a list of valid separators. Pick one and stick to it as close as possible when rigging, it will pay off. For example:

Valid Separators.

Separator	example	
<i>(nothing)</i>	hand Left	→ hand Right
<i>_ (underscore)</i>	Hand_ L	→ Hand_ R
<i>. (point)</i>	hand. l	→ hand. r
<i>- (dash)</i>	Foot- l	→ Foot- r
<i>(space)</i>	pelvis LEFT	→ pelvis RIGHT

Note that all examples above are also valid with the left/right part placed before the name. You can only use the short L/R code if you use a separator (i.e. `handL/handR` won't work!).

- Before Blender handles an armature for mirroring or flipping it first removes the number extension, if it's there (like `.001`)
- You can copy a bone named `bla.L` and flip it over using `W » Flip Left-Right Names`. Blender will name the copy `bla.L.001` and flipping the name will give you `bla.R`.

Bone name flipping

Mode: Edit mode

Hotkey: W4

Menu: Armature » Flip Left & Right Names

You can flip left/right markers (see above) in selected bone names, using either Armature » Flip Left & Right Names, or Specials » Flip Left-Right Names (W4). This can be useful if you have constructed half of a symmetrical rig (marked for a left or right side) and duplicated and mirrored it, and want to update the names for the new side. Blender will swap text in bone names according to the above naming conventions, and remove the number extensions if possible.

Auto bone naming

Mode: Edit mode

Hotkey: W5, W6, W7

Menu: Armature » AutoName Left-Right, Armature » AutoName Front-Back, Armature » AutoName Top-Bottom

The three AutoName entries of the Armature and Specials (W) menus allows you to automatically add a suffix to all selected bones, *based on the position of their root relative to the armature center and its local coordinates*:

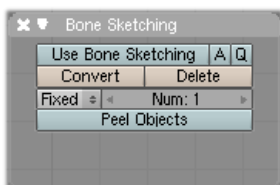
- AutoName Left-Right will add the `.L` suffix to all bones *with a positive X-coordinate root*, and the `.R` suffix to all bones *with a negative X-coordinate root*. If the root is exactly at **0.0** on the X-axis, the X-coordinate of the tip is used. If both ends are at **0.0** on the X-axis, the bone will just get the point, with no L/R (as Blender cannot decide whether it is a left or right bone...).
- AutoName Front-Back will add the `.Bk` suffix to all bones *with a positive Y-coordinate root*, and the `.Fr` suffix to all bones *with a negative Y-coordinate root*. The same as with AutoName Left-Right goes for **0.0** Y-coordinate bones...
- AutoName Top-Bottom will add the `.Top` suffix to all bones *with a positive Z-coordinate root*, and the `.Bot` suffix to all bones *with a negative Z-coordinate root*. The same as with AutoName Left-Right goes for **0.0** Z-coordinate bones...

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Proposed fixes: none

Bone Sketching

If you think that creating a whole rig by hand, bone after bone, is quite boring, be happy: some Blender developers had the same feeling, and created the Skeleton Sketching tool, formerly the Etch-a-ton tool, which basically allows you to “draw” (sketch) whole chains of bones at once.



The Bone Sketching panel in its default (inactive) state.

The Etch-a-ton tool is obviously only available in Edit mode, in the 3D views. You control it through its Bone Sketching panel (P, or Armature » Bone Sketching), and mouse (LMB  to draw strokes, and RMB  for gestures). Showing its tool panel won't enable sketching – *you must click on the Use Bone Sketching button to start drawing bone chains* (else, you remain in the standard Edit mode...).

Sketching is done in two steps:

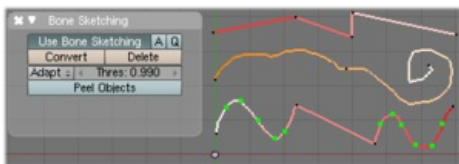
1. [Drawing some “smooth” and/or polygonal lines](#) (called “strokes”). Each stroke corresponds to a chain of bones.
2. [Converting these strokes into real chains of bones](#), using different methods.

The point of view is important, as it determines the future bones' roll angle: *the Z axis of a future bone will be aligned with the view Z axis of the 3D view in which you draw its “parent” stroke (unless you use the Template converting method...).* Strokes are drawn in the current viewplane passing through the 3D cursor, but you can create somewhat “3D” strokes using the Adjustdrawing option in different views (see below).

If you enable the small Quick Sketch option, the two steps are merged in one: once you have finalized the drawing of a stroke (see [below](#)), it is immediately converted to bones (using the current active method) and deleted. This option makes bone sketching quick and efficient, but you lose all the advanced stroke edition possibilities...

Sketches are not saved into Blender files, so you can't interrupt a sketching session without losing all your work! Note also that the *sketching is common to the whole Blender session*, i.e. there is only one set of strokes (one sketch) in Blender, and not one per armature, or even per file...

Drawing Chains





Strokes example. From top to bottom:

- *A selected polygonal stroke of four straight segments, oriented from left to right.
- *An unselected free stroke of two segments, oriented from left to right.
- *A selected mixed stroke, with one straight segment between two free ones, and oriented from right to left.

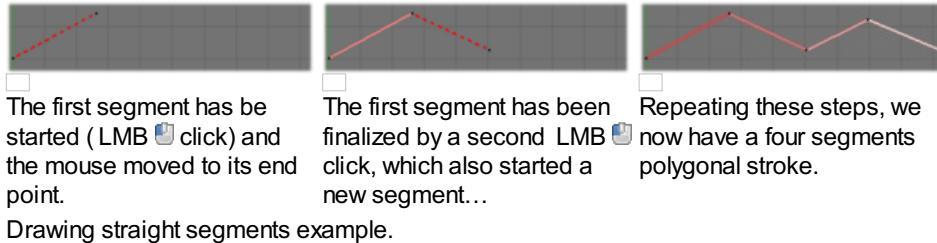
Note also that the armature being edited is empty (has no bones), so you can only see its object center (pink dot, at the bottom).

So, each stroke you draw will be a chain of bones, oriented from the starting point (the reddest or most orange part of the stroke) to its end (its whitest part). A stroke is made of several *segments*, delimited by small black dots – *there will be at least one bone per segment* (except with the Template conversion method, see [next page](#)), so all black points materialize future bones' ends. There are two types of segments, which can be mixed together:




Straight Segments

To create a straight segment, click LMB  at its starting point. Then move the mouse cursor, without pressing any button – a dashed red line materializes the future segment. Click LMB  again to finalize it.

Each straight segment of a stroke will always create one and only one bone, whatever convert algorithm you use (excepted the Template conversion method).

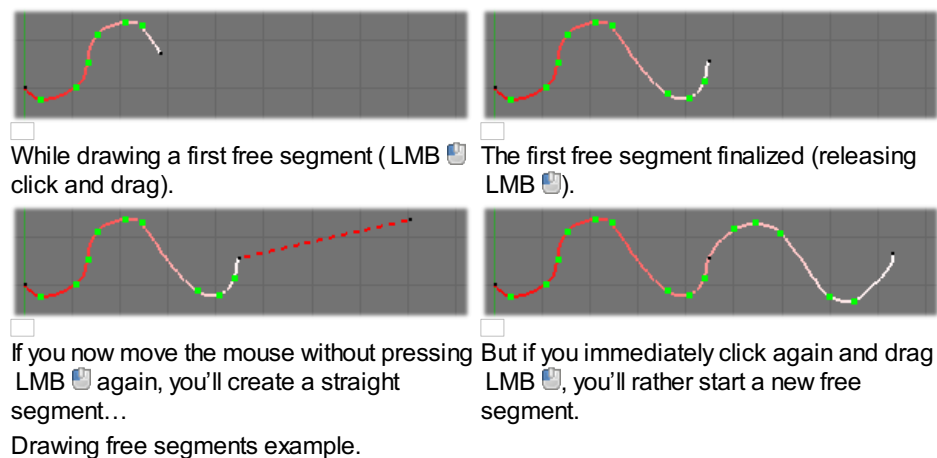



Free Segments

To create a free (curved) segment, click *and hold* LMB  at its starting point. Then draw your segment by moving the mouse cursor – as in any paint program! Release LMB  to finalize the segment – you will then be creating a new *straight* segment, so if you would rather start a new *free* segment, you must immediately re-press LMB ...



The free segments of a stroke will create different number of bones, in different manners, depending on the conversion method used. The future bones' ends for the current selected method are materialized by small green dots on those segments, *for the selected strokes only*.

The free segment drawing uses the same Manhattan Dist setting as the [grease pencil tool](#) (User Preferences window, Edit Methods “panel”, Grease Pencil group) to control where and when to add a new point to the segment – so if you feel your free segments are too detailed, raise a bit this value, and if you find them too jagged, lower it.



You finalize a whole stroke by clicking RMB . You can cancel the stroke you are drawing by hitting Esc. You can also snap strokes to underlying meshes by holding Ctrl while drawing. By the way, the Peel Objects button at the bottom of the Bone Sketching panel is the “same thing” as the “monkey” button of the snapping header bar controls shown when Volume snap element is selected – see the [snap to mesh](#) page for details.

Selecting Strokes

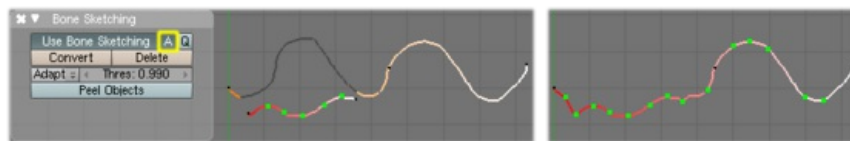
A stroke can be selected (materialized by a solid red-to-white line), or not (shown as a orange-to-white line) – see (*Strokes example*) above. As usual, you select a stroke by clicking RMB  on it, you add one to/remove one from the current selection with a ⇧ Shift RMB  click, and A (de)selects all strokes...

Deleting

Hitting X or clicking on the Delete button (Bone Sketching panel) deletes the selected strokes (be careful, no warning/confirmation pop-up menu here...). See also the [gesture description below](#).

Modifying Strokes

You can adjust, “redraw” your strokes by enabling the Overdraw Sketching option of the Bone Sketching panel. This will modify the behavior of the strokes drawing (i.e. LMB clicks and/or hold): when you draw, you won’t create a new stroke, but rather modify the nearest one. The part of the old stroke that will be replaced by the new one are drawn in gray. *This option does not take into account stroke selection*, i.e. all strokes can be modified this way, not just the selected ones... Note also that even if it is enabled, when you draw to far away from any other existing stroke, you won’t modify any of them, but rather create a new one, as if Overdraw Sketching was disabled.



Adjusting a stroke: the gray part of the “unselected” (orange) stroke will be replaced by the currently drawn “replacement”.

Stroke adjusted.

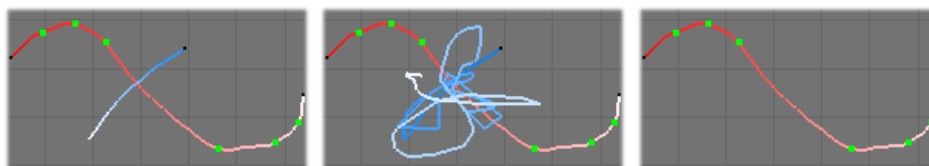
Adjusting stroke example.

Finally, note that there is no undo/redo for sketch drawing...

Gestures

There quite a few things about strokes editing that are only available through gestures. Gestures are started by clicking and holding $\text{Shift} + \text{LMB}$ (when you are not already drawing a stroke...), and materialized by blue-to-white lines. A gesture can affect several strokes at once.

There is no direct way to cancel a gesture once you’ve started “drawing” it. So the best thing to do, if you changed your mind (or made a “false move”), is to continue to draw until you get a disgusting scribble, crossing several time your stroke – in short, something that the gesture system would never recognize!



Damned! I didn’t want to cut this stroke here!

Let’s doodle a bit...

Phew! That was close, but the stroke is still in one piece...

Canceling gesture example.

Cut

To **cut** a segment (i.e. add a new black dot inside it, making two segments out of one), “draw” a strait line crossing the chosen segment where you want to split it.



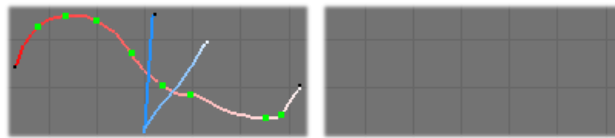
Gesture.

Result.

Cut gesture example.

Delete

To **delete** a stroke, draw a “V” crossing twice the stroke to delete.



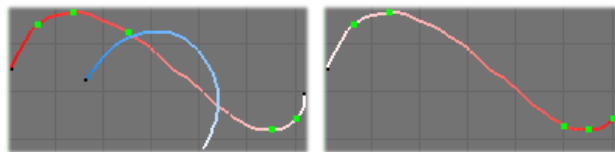
Gesture.

Result.

Delete gesture example.

Reverse

To **reverse** a stroke (i.e. that the future chain of bones will be reversed), draw a “C” crossing twice the stroke to reverse.



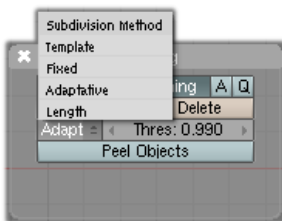
Gesture.

Result.

Reverse gesture example.

Converting to Bones

Once you have one or more selected strokes, you can convert them to bones, using either the Convert button of the Bone Sketching panel, or the corresponding gesture (see [above](#)). Each selected stroke will generate a chain of bones, oriented from its reddest end to its whitest one. Note that converting a stroke does not delete it.



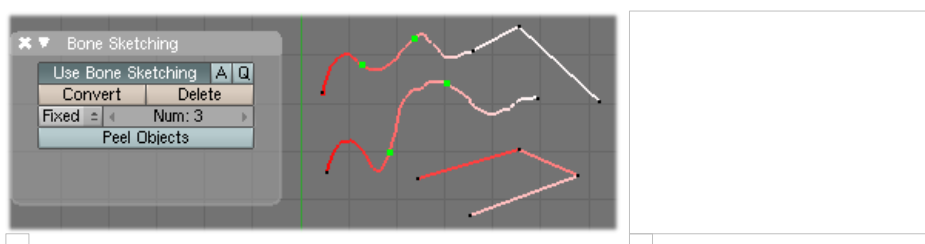
The Subdivision Method drop-down list of the Bone Sketching panel.

There are four different conversion methods – three “simple” ones, and one more advanced and complex, Template, that reuses bones from the same armature or from another one as a template for the strokes to convert, and which is detailed in [the next page](#). Anyway, remember that *straight segments are always converted to one and only one bone* (except for the Template conversion method), and that the future bones’ ends are shown as green dots on selected free segments.

Remember also that the roll rotation of the created bones has been set during their “parent” stroke drawing (except for the Template conversion method) – their Z axis will be aligned with the view Z axis of the active 3D view at draw time.

Fixed

With this method, each free segment of the selected strokes will be uniformly divided in n parts (set in Num numeric field), i.e. will give n bones.



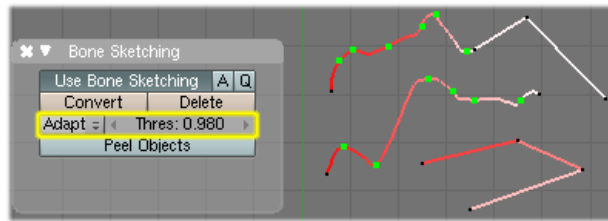
The Fixed conversion settings and its preview on selected strokes. The Fixed conversion result.

Fixed stroke-to-bone conversion example.

Adaptive

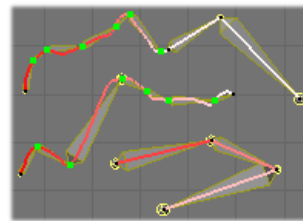
With this method, each free segment of the selected strokes will create as much bones as necessary to follow its shape closely enough – this “closely enough” parameter being set by the Threshold numeric field, higher values giving more bones following more closely the segments’ shape.

So the more twisted a free segment, the more bones it will generate.



The Adaptive conversion settings and its preview on selected strokes.

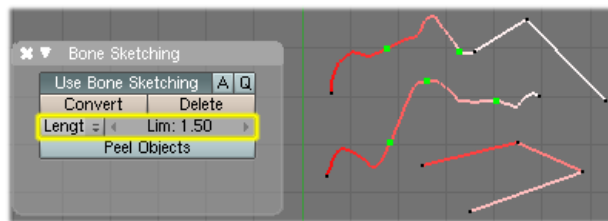
Adaptive stroke-to-bone conversion example.



The Adaptive conversion result.

Length

With this method, each free segment of the selected strokes will create as much bones as necessary, so that none of them is longer than the Len numeric field value (in Blender Units).



The Length conversion settings and its preview on selected strokes.

Length stroke-to-bone conversion example.



The Length conversion result.

Template

This is a more complex topic, detailed in its [own page](#).

Retarget

...

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Proposed fixes: none

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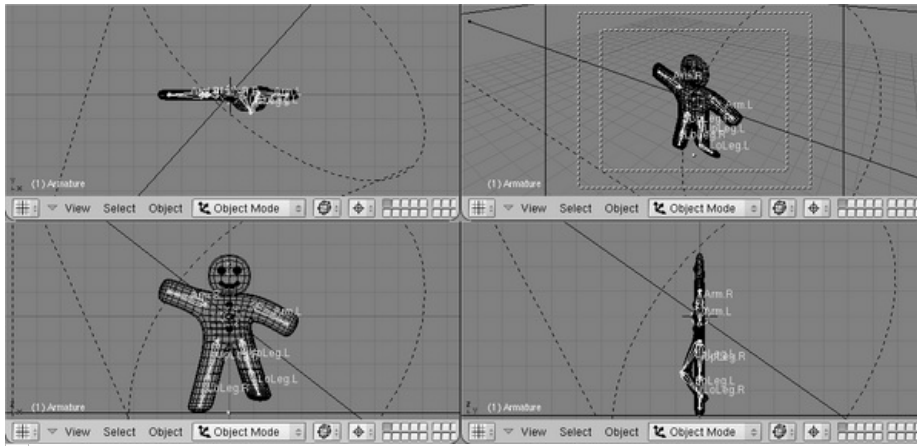
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Skinning

We have seen in [previous pages](#) how to design an armature, create chains of bones, etc. Now, having a good rig is not the final goal – unless you want to produce a “Dance Macabre” animation, you’ll likely want to put some flesh on your skeletons! Surprisingly, “linking” an armature to the object(s) it should transform and/or deform is called the “skinning” process...



The ginebread mesh skinned on its armature...

In Blender, you have two main skinning types:

- You can [Parent/Constrain Objects to Bones](#) – then, when you transform the bones in Pose mode, their “children” objects are also transformed, exactly as with a standard parent/children relationship... *The “children” are **never** deformed when using this method.*
- You can [Using the Armature modifier on entire Mesh](#), and then, some parts of this object to some bones inside this armature. This is the more complex and powerful method, and *the only way to really deform the geometry of the object*, i.e. to modify its vertices/control points relative positions.

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Posing

Once your armature is [skinned](#) by the needed object(s), you can start to pose it. Basically, by transforming its bones, you deform or transform the skin object(s). But you don't do that in Edit mode – remember that in this mode, you edit *the default, base, “rest” position of your armature*. You can't neither use the Object mode, as here you can only transform whole objects...

So, armatures in Blender have a third mode, Pose, dedicated to this process. It's a sort of “object mode for bones”. In rest position (as edited in Edit mode), each bone has its own position/rotation/scale to neutral values (i.e. **0.0** for position and rotation, and **1.0** for scale). Hence, when you edit a bone in Pose mode, you create an offset in its transform properties, from its rest position – this is quite similar to [meshes' relative shape keys](#), in fact.

Posing Section Overview

In this section, we will see:

- The [visualization features](#) specific to Pose mode.
- How to [select and edit bones](#) in this mode.
- How to [use pose library](#).
- How to [use constraints](#) to control your bones' DoF (degrees of freedom).
- How to [use inverse kinematics features](#).

Even though it might be used for completely static purposes, posing is heavily connected with [animation features and techniques](#). In this part, we try to focus on animation-independent posing, but this isn't always possible. So if you know nothing about animation in Blender, it might be a good idea to read first the relevant chapter (follow the link above), and then come back here...

See Also

As usual, see the [tutorials](#) for more demonstrative examples, and especially [this BSoD one](#).

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Rigging/Posing/Visualization>"

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Proposed fixes: none

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Proposed fixes: none

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Rigging/Posing/Pose_Library"

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Void page

Proposed fixes: none

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Rigging/Posing/Constraints>"

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Inverse Kinematics

IK is a way of simplifying the animation process, making it possible to make more advanced animations with less effort.

Automatic IK

Automatic-IK is a tool for making simple demonstration poses. It is located under the tool shelf in 3D view in pose mode. It should only be used for quick and dirty demonstration as it can not use constraints. The actual effect is the same as if you gave the end of each bone chain a IK constraint with chain length of 0(infinity).

IK Constraints

...

Spline IK

Spline IK is a constraint which aligns a chain of bones along a curve. By leveraging the ease and flexibility of achieving aesthetically pleasing shapes offered by curves and the predictability and well integrated control offered by bones, Spline IK is an invaluable tool in the riggers' toolbox. It is particularly well suited for rigging flexible body parts such as tails, tentacles, and spines, as well as inorganic items such as ropes.

Full description of the settings for the spline IK are detailed on the [Spline IK](#) page.

Basic Setup

The Spline IK Constraint is not strictly an 'Inverse Kinematics' method (i.e. IK Constraint), but rather a 'Forward Kinematics' method (i.e. normal bone posing). However, it still shares some characteristics of the IK Constraint, such as operating on multiple bones not being usable for Objects, and being evaluated after all other constraints have been evaluated. It should be noted that if a Standard IK chain and a Spline IK chain both affect a bone at the same time the Standard IK chain takes priority. Such setups are best avoided though, since the results may be difficult to control.

To setup Spline IK, it is necessary to have a chain of connected bones and a curve to constrain these bones to.

1. With the last bone in the chain selected, add a '[Spline IK](#)' Constraint from the Bone Constraints tab in the Properties Editor. The Bone Constraints tab shows up when you're in pose mode.
2. Set the 'Chain Length' setting to the number of bones in the chain (starting from and including the selected bone) that should be influenced by the curve.
3. Finally, set the 'Target' field to the curve that should control the curve.

Congratulations, the bone chain is now controlled by the curve.

Settings and Controls

Roll Control

To control the 'twist' or 'roll' of the Spline IK chain, the standard methods of rotating the bones in the chain along their y-axes still apply. For example, simply rotate the bones in the chain around their y-axes to adjust the roll of the chain from that point onwards. Applying copy rotation constraints on the bones should also work.

Offset Controls

The entire bone chain can be made to follow the shape of the curve while still being able to be placed at an arbitrary point in 3D-space when the 'Chain Offset' option is enabled. By default, this option is not enabled, and the bones will be made to follow the curve in its untransformed position.

Thickness Controls

The thickness of the bones in the chain is controlled using the constraint's 'XZ Scale Mode' setting. This setting determines the method used for determining the scaling on the X and Z axes of each bone in the chain.

The available modes are:

- None - this option keeps the X and Z scaling factors as 1.0
- Volume Preserve - the X and Z scaling factors are taken as the inverse of the Y scaling factor (length of the bone), maintaining the 'volume' of the bone
- Bone Original - this options just uses the X and Z scaling factors the bone would have after being evaluated in the standard way

In addition to these modes, there is an option, 'Use Curve Radius'. When this option is enabled, the average radius of the radii of the points on the curve where the endpoints of each bone are placed, are used to derive X and Z scaling factors. This allows the scaling effects, determined using the modes above, to be tweaked as necessary for artistic control.

Tips for Nice Setups

- For optimal deformations, it is recommended that the bones are roughly the same length, and that they are not too long, to facilitate a better fit to the curve. Also, bones should ideally be created in a way that follows the shape of the curve in its 'rest pose' shape, to minimise the problems in areas where the curve has sharp bends which may be especially noticeable when stretching is disabled.
- For control of the curve, it is recommended that hooks (in particular, Bone Hooks, which are new in 2.5) are used to control the control-verts of the curve, with one hook per control-vert. In general, only a few control-verts should be needed for the curve (i.e. 1 for every 3-5 bones offers decent control).
- The type of curve used does not really matter, as long as a path can be extracted from it that could also be used by the Follow Path Constraint. This really depends on the level of control required from the hooks.
- When setting up the rigs, it is currently necessary to have the control bones (for controlling the curve) in a separate armature to those used for deforming the meshes (i.e. the deform rig containing the Spline IK chains). This is to avoid creating pseudo "Dependency Cycles", since Blender's Dependency Graph can only resolve the dependencies the control bones, curves, and Spline IK'ed bones on an object by object basis.

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Constraints

Description

Constraints are object features, i.e. they control in various fashions the objects' *transform properties* (position, rotation and scale). In fact, constraints are in a way the object counterpart of the [modifiers](#), which work on the object *data* (i.e. meshes, curves, etc.).

All constraints share a basic [common interface](#), again with many similarities with the modifiers' one.

Use of constraints

Even though constraints might be very useful in static scenes (as they can help to automatically position/rotate/scale objects), they were first designed for animation, as they allow you to limit/control the freedom of an object, either in absolute (i.e. in global space), or relatively to other objects.

Page status ([reviewing guidelines](#))

Text

Technical unclear explanation

The entire paragraph is impenetrable, too much jargon, unless you're an opengl programmer it means nothing.

Proposed fixes:

Needs a rewrite in much clearer user friendly language.

Also note that constraints internally work using 4x4 transformation matrices only. When you use settings for specific rotation or scaling constraining, this information is being derived from the matrix only, not from settings in a Bone or Object. Especially for combining rotations with non-uniform or negative scaling this can lead to unpredictable behavior.

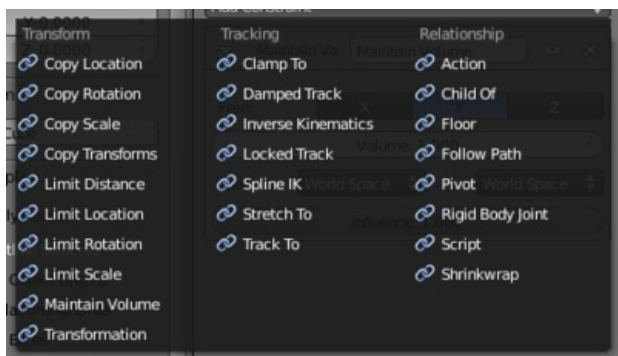
Constraining bones

Finally, there is a great rigging feature in Blender: in Pose mode, each bone of an armature behaves a bit like a standard object, and, as such, can be constrained. Most constraints work well with both objects and bones, but there are a few exceptions, that will be noted in the relevant constraints pages.

To learn more:

- Read about using constraints in object animation in the [Animation chapter](#)
- Read about using constraints in rigging in the [Armatures](#)

Available Constraints



Constraint menu

There are several types of constraints. We can classify them in three families:

Page status ([reviewing guidelines](#))

Partial page Text

Missing the Motion Tracking category of constraints

Images

Old Screenshot

Add Constraints list missing Motion Tracking .
25-Manual-Constraints-Menu.png

Proposed fixes:

The category for Motion Tracking constraints needs to be written
Image needs updating

- [Transform](#)
- [Tracking](#)
- [Relationship](#)

There are constraints that works with their *owner* object and others that need a second object (the *target*) to work, sometimes of a specific type (e.g. a curve). In this case targeted constraints are shown as a dark blue dashed line drawn in the 3D view between the owner and target objects.

Transform Constraints

These constraints directly control/limit the transform properties of its owner, either absolutely or relatively in terms of its target properties.

Copy Location	Copies the location of the target (with an optional offset) to the owner, so that both move together.
Copy Rotation	Copies the rotation of the target (with an optional offset) to the owner, so that both rotate together.
Copy Scale	Copies the scale of the target (with an optional offset) to the owner, so that both scale together.
Limit Distance	Limits the position of the owner, so that it is nearer/farer/exactly at the specified distance from the target.
Limit Location	Limits the owner's location inside a given range.
Limit Rotation	Limits the owner's rotation inside a given range.
Limit Scale	Limits the owner's scale inside a given range.
Transformation	Uses a property of the target (location, rotation or scale), to control a property (the same or a different one) of the owner.
Maintain Volume	Maintains the volume of a bone or an object.

Tracking Constraints

These constraints try, in various ways, to adjust their owner's properties so that it "points at" or "follows" the target.

Clamp To	Clamps the owner to a given curve target.
Damped Track	
Inverse Kinematics	Bones only. Creates a chain of bones controlled by the target, using inverse kinematics.
Locked Track	The owner is tracked to the given target, but with a given axis' orientation locked.
Spline IK	
Stretch To	Stretch the owner to the given target.
Track To	The owner is tracked to the given target.

Relationship Constraints

These are "misc" constraints.

Action	The owner executes an action, controlled by the target (driver).
Child Of	Allows a selective application of the effects of parenting to another object.
Floor	Uses the target's position (and optionally rotation) to define a "wall" or "floor" that the owner won't be able to cross.
Follow Path	The owner moves along the curve target.
Pivot	
Rigid Body Joint	Creates a rigid joint (like hinge...) between the owner and the "target" (child object).
Script	Uses a Python script as constraint.
Shrinkwrap	Limits the location of the owner at <i>the surface</i> (among other options) of the target.

Text

Constraints Common Interface

A section of the paragraph points to a rigging chapter, but there is not one yet so the link is red.

Constraints Header

Paragraph mentions that "A constraint stack example" that is a Child Of Constraint but that is not what is shown in the picture.

The target

Paragraph that starts "Most constraints need another "target" --- its center point --- should be "its object origin"

Paragraph that starts "When you type in the OB field a" --- If you let it empty, --- "If you leave it empty,"

The Constraint Space (Space)

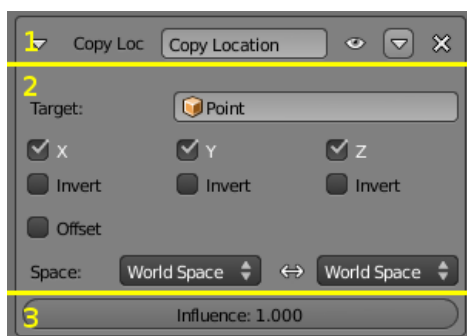
Paragraph that starts "For many constraints you can choose in which space" --- should be reworded to --- "For many constraints you can choose in which space it is evaluated/applied. In the Space drop-down lists, the right side one is the space that the owner is evaluated in (Owner Space). When such a constraint uses a target, you can also choose in which space the target is evaluated (Target Space). The Target Space drop down list is on the left side. Both lists have the same options, depending on whether the element (owner or target) is a regular object, or a bone:"

Local Space

Paragraph that starts "The bone properties are evaluated in its own local" --- mentions bones but doesn't just apply to bones. If it is meant to just apply to bones that need to be indicated. The list of space types need to be named as they are in the Blender drop down list. Example Local (Without Parent) Space should be Local Space (bones only), and Local Space (objects only) etc. Also the each of the descriptions need examples and pictures to make clear exactly what they mean. As the terminology is not very clear. Just saying experiment to figure out how they work is not acceptable.

Proposed fixes: none

Constraints Common Interface



The three parts of a constraint interface

As with [modifiers](#), an object (or bone, see the [rigging chapter](#) for details) can use several constraints at once. Hence, these constraints are organized in a stack, that control their order of evaluation (from top to bottom).

All constraints share a common basic interface, packed up in a sort of sub-panel, that is split in three parts:

1. The header, gathering most common settings.
2. The constraint's specific settings.
3. The influence and animation controls (the Rigid Body Joint constraints have no influence setting).

Constraints Header



A constraint header

The header of a constraint "sub-panel" is the same for all. From left to right, you have:

A small arrow

This control allows you to show/hide the constraint's settings. In the (*A constraint stack example*) picture above, the Child Of constraint is reduced this way.

The constraint type

This is just a static text showing you what this constraint is...

The name field

Here you can give your constraint a more meaningful name than the default one.

This control has another *important* purpose: it turns red when the constraint is not functional (as in *A constraint header*). As most constraints need a second “target” object to work (see below), when just added, they are in “red state”, as Blender cannot guess which object or bone to use as target. This can also happen when you chose an invalid set of settings, e.g. with a [Track To constraint](#) of which the To and Up vectors are both set to the same axis.

As said above, constraints in “red state” are ignored during the stack evaluation.

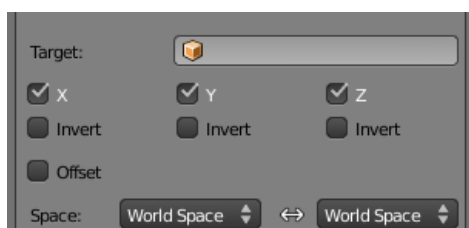
The “up”/“down” buttons

As seen above, these allow you to move a constraint up/down in the stack.

The “X” control

As seen above, this will delete (remove from the stack) the constraint.

Constraints Settings



The central part of a constraint's subpanel contains the constraint's settings, the target, and constraint space

The constraints settings area are of course specific to each constraint type. However, there are two points that are common to many constraints, so we will detail them here.

The target

Most constraints need another “target” object or bone to “guide” them. You select which by selecting its name in the Target field. Except for a few cases, you can use any type of object (camera, mesh, empty...), its center point will be the target point.

When you type in the OB field a mesh or lattice name, a second Vertex Group field appears just below. If you let it empty, the mesh or lattice will be used as a standard object target. But if you enter in this Vertex Group field the name of one of the mesh's or lattice's vertex groups, then the constraint will use the median point of this vertex group as target.

Similarly, if you type in the OB field an armature name, a second Bone field appears just below. If you enter in it the name of one of the armature's bones, then the constraint will use this bone's *root* as target. In some constraints, when you use a bone as target, another Head/Tail numeric field will also appear, that allows you to select where along the bone the target point will lay, from root (**0.0**) to tip (**1.0**) (remember that currently, in Blender UI, bones' roots are called “heads”, and bones' tips, “tails”...).

The Constraint Space (Space)

For many constraints you can choose in which space it is evaluated/applied, in the Owner Space drop-down list (the right one). When such a constraint uses a target, you can also choose in which space the target is evaluated, in its Target Space drop-down list (the left one). Both lists have the same options, depending on whether the element (owner or target) is a regular object, or a bone:

Local Space

The bone properties are evaluated in its own local space, i.e. based on its rest position (without taking into account its parent bones' transformations in its chain, neither its armature object's transformation).

Local With Parent (bones only)

The bone properties are evaluated in its own local space, *including* the transformations due to a possible parent relationship (i.e. due to the chain's transformations above the bone).

Pose Space (bones only)

The bone properties are evaluated in the armature object local space (i.e. independently from the armature transformations in Object mode). Hence, if the armature object has null transformations, Pose Space will have the same effect as World Space...

Local (Without Parent) Space (objects only)

The object properties are evaluated in its own local space, *without* the transformations due to a possible parent relationship.

World Space (default setting)

Here the object's or bone's properties are evaluated in the global coordinate system. This is the easiest to understand and most natural behavior, as it always uses the "visual" transform properties (i.e. as you see them in the 3D views).

Understanding the Constraint Space effects is not really easy (unless you are a geometry genius...). The best thing to do is to experiment their different combinations, using e.g. two empties (as they materialize clearly their axes), and a Copy Rotation constraint (as rotations are the most demonstrative transformations, to visualize the various spaces specificities...).

Influence



Influence

At the bottom of nearly all constraints, you have the Influence slider, which controls the influence of the constraint on its owner. As you might expect, **0.0** means that the constraint has no effect, and **1.0** means that the constraint has full effect. Using in-between values, you can have several constraints all working together on the same owner's properties. Note that if a constraint has a full influence on a given property, all other constraints above in the stack working on that same property will have no effect at all.

But the best thing with influence is that you can animate it with an lpo curve – see [the constraints page of the animation chapter](#) for more details about this.

The Constraints Stack



A constraint stack example

As said above, constraints are evaluated from top to bottom of the constraint stack, shown/materialized in the Constraints panel.

1. In (*A constraint stack example*), first the location of the lamp is copied to the owner object.
2. The copy rotation constraint is ignored (red name, see below).
3. So the next constraint evaluated is the Child Of one, which is currently reduced.
4. Finally, the size of our cube is bounded by the Limit Scale last constraint.

So here, the size of the cube is first controlled by the target of the Child Of constraint, within the limits allowed by the next Limit Scale constraint... As with modifiers, order is crucial!

You can move a constraint up and down the stack by using the small up/down arrow buttons that are drawn in its header, to the right of the constraint name. These buttons are only visible when needed, i.e. the top constraint has only the “down” button, the bottom constraint, only the “up” one – and when there is only one constraint in the stack, both buttons are hidden.

Page status ([reviewing guidelines](#))

Text

The Constraints Stack

The Paragraph that starts "As said above, constraints are" --- should be reworded "As said above, constraints are evaluated from top to bottom of the constraint stack, shown in the Constraints panel."

Adding/Removing a Constraint

The Paragraph that starts "Note that these pop-up menus do not" --- should be reworded "Note that these pop-up menus do not display all the available constraints."

Proposed fixes: none

Adding/Removing a Constraint

To add a constraint, you can, in the Constraints panel, click on the... Add Constraint button! A menu shows up, listing all available constraints for current active object (or bone in Pose mode (in which case the constraint will show up in the bone constraints menu)). The new constraint is *always* added at the bottom of the stack.

You can also, in a 3D view, either:

- Select only the future owner, hit Ctrl+Shift+C, and in the Add Constraint to New Empty Object menu that pops-up, select the constraint you want to add. If the chosen constraint needs it, a new Empty object will be automatically added as target, positioned at the owner's center, and with null rotation.

- Select first, the future target, and then the future owner, hit Ctrl⇧ ShiftC, and in the Add Constraint to Active Object (or Add Constraint to Active Bone) menu that pops-up, select the constraint you want to add. If the chosen constraint needs it, the other selected object/bone will be used as target.

Note that these pop-up menus do not propose you all the available constraints...

To remove a constraint, click on the "X" button of the header of the constraint you want to delete, in the Constraints panel. You can also remove all constraints from the selected object(s), using the Object » Constraints » Clear Object Constraints (or Pose » Constraints » Clear Pose Constraints... or hit CtrlAltC).

Copy Location Constraint

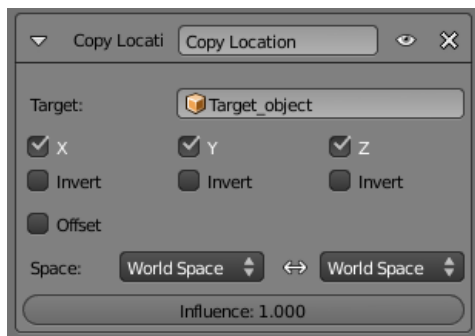
Description

The Copy Location constraint forces its owner to have the same location as its target.



Note that if you use such a constraint on a *connected* bone, it will have no effect, as it is the parent's tip which controls the position of your owner bone's root.

Options



Copy Location panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Head/Tail

If a Bone is set as Target, a new field is displayed offering the optional choice where along this bone lays the target point.

Vertex Group

If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

X, Y, Z

These buttons control which axes (i.e. coordinates) are constrained – by default, all three ones are.

Invert

The Invert buttons invert their respective preceding coordinates.

Offset

When enabled, this control allows the owner to be translated (using its current transform properties), relatively to its target's position.

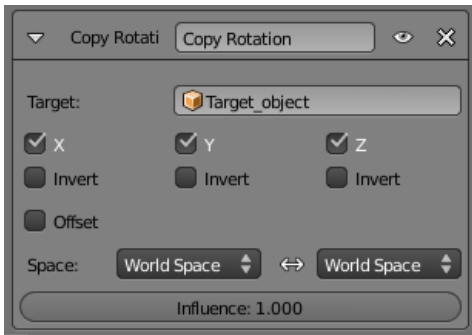
Space

This constraint allows you to chose in which space evaluate its owner's and target's transform properties.

Copy Rotation Constraint

The Copy Rotation constraint forces its owner to match the rotation of its target.

Options



Copy Rotation panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Head/Tail

If a Bone is set as Target, a new field is displayed offering the optional choice where along this bone lays the target point.

Vertex Group

If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

X, Y, Z

These buttons control which axes are constrained – by default, all three are on.

Invert

The Invert buttons invert their respective rotation values.

Offset

When enabled, this control allows the owner to be rotated (using its current transform properties), relatively to its target's orientation.

Space

This constraint allows you to chose in which space evaluate its owner's and target's transform properties.

Copy Scale Constraint

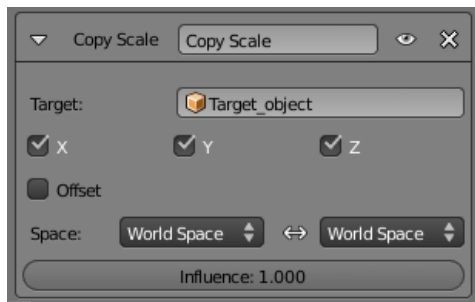
Description

The Copy Scale constraint forces its owner to have the same scale as its target.



Here we talk of **scale**, not of **size**! Indeed, you can have two objects, one really bigger than the other, and yet both of them having the same scale. This is also true with bones: in Pose mode, they all have a unitary scale when they are in rest position, whatever being there visual length.

Options



Copy Scale panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Head/Tail

If a Bone is set as Target, a new field is displayed offering the optional choice where along this bone lays the target point.

Vertex Group

If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

X, Y, Z

These buttons control along which axes the scale is constrained – by default, it is enabled along all three.

Offset

When enabled, this control allows the owner to be scaled (using its current transform properties), relatively to its target's scale.

Space

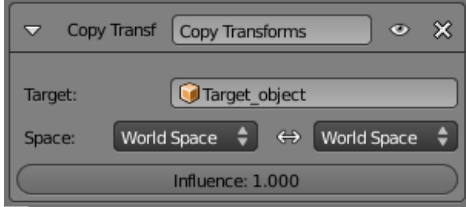
This constraint allows you to chose in which space evaluate its owner's and target's transform properties.

Copy Transforms Constraint

Description

The Copy Transforms constraint forces its owner to have the same transforms as its target.

Options



Copy Transforms panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Head/Tail

If a Bone is set as Target, a new field is displayed offering the optional choice where along this bone lays the target point.

Vertex Group

If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

Space

This constraint allows you to chose in which space evaluate its owner's and target's transform properties.

Limit Distance Constraint

Description

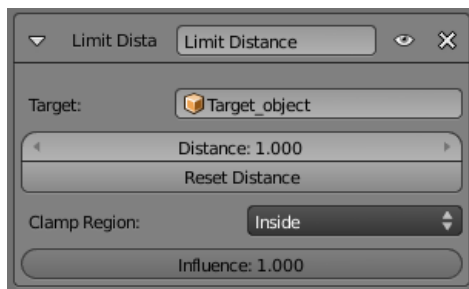
The Limit Distance constraint forces its owner to stay either farther than, nearer than, or exactly at a given distance from its target. In other words, the owner's location is constrained either outside, inside, or at the surface of a sphere centered on its target.

When you specify a (new) target, the Distance value is automatically set to correspond to the distance between the owner and this target.



Note that if you use such a constraint on a *connected* bone, it will have no effect, as it is the parent's tip which controls the position of your owner bone's root.

Options



Limit Distance panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Head/Tail

If a Bone is set as Target, a new field is displayed offering the optional choice where along this bone lays the target point.

Vertex Group

If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

Distance

This numeric field sets the limit distance, i.e. the radius of the constraining sphere.

Reset Distance

When clicked, this small button will reset the Distance value, so that it corresponds to the actual distance between the owner and its target (i.e. the distance before this constraint is applied).

Clamp Region

The Limit Mode drop-down menu allows you to chose how to use the sphere defined by the Distance setting and target's center:

Inside (default)

The owner is constrained *inside* the sphere.

Outside

The owner is constrained *outside* the sphere.

Surface

The owner is constrained *on the surface* of the sphere.

Limit Location Constraint

Description

An object or *unconnected* bone can be moved around the scene along the X, Y and Z axes. This constraint restricts the amount of allowed translations along each axis, through lower and upper bounds.

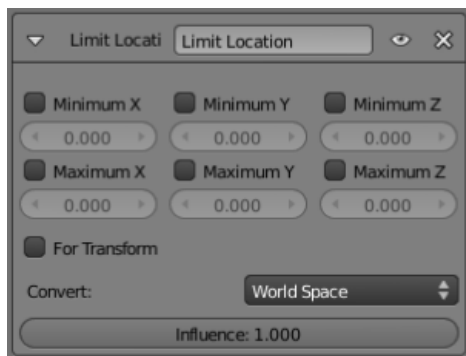
The limits for an object are calculated from its center, and the limits of a bone, from its root.

It is interesting to note that even though the constraint limits the visual and rendered location of its owner, its owner's data block still allows (by default) the object or bone to have coordinates outside the minimum and maximum ranges. This can be seen in its *Transform Properties* panel (N). When an owner is grabbed and attempted to be moved outside the limit boundaries, it will be constrained to those boundaries visually and when rendered, but internally, its coordinates will still be changed beyond the limits. If the constraint is removed, its ex-owner will seem to jump to its internally specified location.

Similarly, if its owner has an internal location that is beyond the limits, dragging it back into the limit area will appear to do nothing until the internal coordinates are back within the limit threshold (unless you enabled the *For Transform* option, see below).

Setting equal the min and max values of an axis, locks the owner's movement along that axis... Although this is possible, using the *Transformation Properties* axis locking feature is probably easier!

Options



Limit Location panel

Minimum X, Minimum Y, Minimum Z

These buttons enable the lower boundary for the location of the owner's center along respectively the X, Y and Z axes of the chosen Space.

The numeric field below the them controls the value of their limit.

Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

Maximum X, Maximum Y, Maximum Z

These buttons enable the upper boundary for the location of the owner's center along respectively the X, Y and Z axes of the chosen Space.

Same options as above.

For Transform

We saw that by default, even though visually constrained, the owner can still have coordinates out of bounds (as shown by the *Transform Properties* panel). Well, when you enable this button, this is no more possible – the owner's transform properties are also limited by the constraint.

Note however that the constraint does not directly modifies the coordinates: you have to grab one way or the other its owner, for this to take effect...

Convert

This constraint allows you to chose in which space evaluate its owner's transform properties.

Limit Rotation Constraint

Description

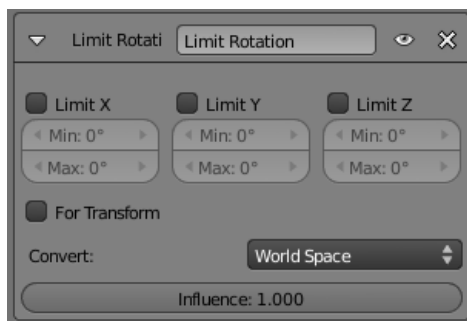
An object or bone can be rotated around the X, Y and Z axes. This constraint restricts the amount of allowed rotations around each axis, through lower and upper bounds.

It is interesting to note that even though the constraint limits the visual and rendered rotations of its owner, its owner's data block still allows (by default) the object or bone to have rotation values outside the minimum and maximum ranges. This can be seen in the Transform Properties panel (N). When an owner is rotated and attempted to be rotated outside the limit boundaries, it will be constrained to those boundaries visually and when rendered, but internally, its rotation values will still be changed beyond the limits. If the constraint is removed, its ex-owner will seem to jump to its internally specified rotation.

Similarly, if its owner has an internal rotation that is beyond the limit, rotating it back into the limit area will appear to do nothing until the internal rotation values are back within the limit threshold (unless you enabled the For Transform option, see below).

Setting equal the min and max values of an axis, locks the owner's rotation around that axis... Although this is possible, using the Transformation Properties axis locking feature is probably easier.

Options



Limit Rotation panel

Limit X, LimitY, LimitZ

These buttons enable the rotation limit around respectively the X, Y and Z axes of the owner, in the chosen Space. The Min and Max numeric fields to their right control the value of their lower and upper boundaries, respectively.

Note that:

- If a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.
- Unlike the [Limit Location constraint](#), you cannot enable separately lower or upper limits...

For Transform

We saw that by default, even though visually constrained, the owner can still have rotations out of bounds (as shown by the Transform Properties panel). Well, when you enable this button, this is no more possible – the owner transform properties are also limited by the constraint.

Note however that the constraint does not directly modifies the rotation values: you have to rotate one way or the other its owner, for this to take effect...

Convert

This constraint allows you to chose in which space evaluate its owner's transform properties.

Limit Scale Constraint

Description

An object or bone can be scaled along the X, Y and Z axes. This constraint restricts the amount of allowed scalings along each axis, through lower and upper bounds.



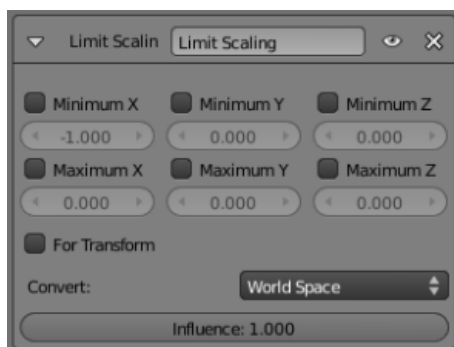
This constraint does not tolerate negative scale values (those you might use to mirror an object...): when you add it to an object or bone, even if no axis limit is enabled, nor the For Transform button, as soon as you scale your object, all negative scale values are instantaneously inverted to positive ones... And the boundary settings can only take strictly positive values.

It is interesting to note that even though the constraint limits the visual and rendered scale of its owner, its owner's data block still allows (by default) the object or bone to have scale values outside the minimum and maximum ranges (as long as they remain positive!). This can be seen in its Transform Properties panel (N). When an owner is scaled and attempted to be moved outside the limit boundaries, it will be constrained to those boundaries visually and when rendered, but internally, its coordinates will still be changed beyond the limits. If the constraint is removed, its ex-owner will seem to jump to its internally specified scale.

Similarly, if its owner has an internal scale that is beyond the limits, scaling it back into the limit area will appear to do nothing until the internal scale values are back within the limit threshold (unless you enabled the For Transform option, see below – or your owner has some negative scale values).

Setting equal the min and max values of an axis, locks the owner's scaling along that axis. Although this is possible, using the Transformation Properties axis locking feature is probably easier.

Options



Limit Scale panel

Minimum/Maximum X, Y, Z

These buttons enable the lower boundary for the scale of the owner along respectively the X, Y and Z axes of the chosen Space. The Min and Max numeric fields to their right control the value of their lower and upper boundaries, respectively.

Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

For Transform

We saw that by default, even though visually constrained, and except for the negative values, the owner can still have scales out of bounds (as shown by the Transform Properties panel). Well, when you enable this button, this is no more possible – the owner transform properties are also limited by the constraint.

Note however that the constraint does not directly modifies the scale values: you have to scale one way or the other its owner, for this to take effect.

Convert

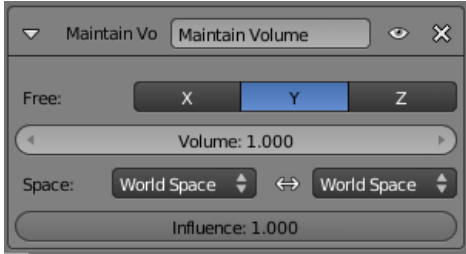
This constraint allows you to chose in which space evaluate its owner's transform properties.

Maintain Volume Constraint

Description

The Maintain Volume constraint the volume of a mesh or a bone to a given ratio of its original volume.

Option



Maintain Volume panel

Free X/Y/Z

The free scaling axis of the object.

Volume

The bone's rest volume. Default is 1.0.

Space

This constraint allows you to chose in which space evaluate its owner's transform properties.

See also

- [Harkyman on the development of the Maintain Volume constraint](#), March 2010

Transformation Constraint

Description

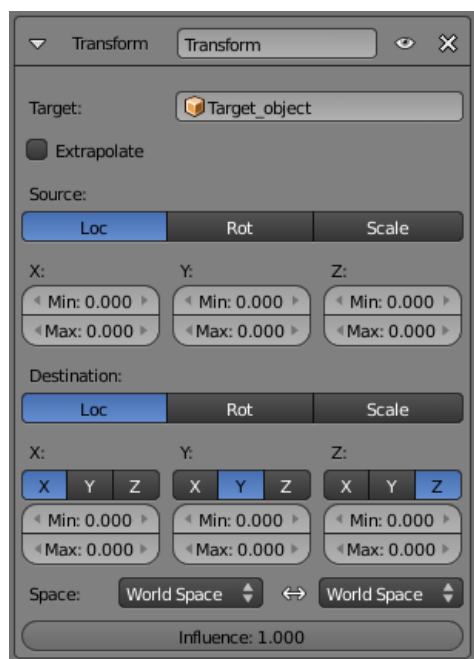
This constraint is more complex and versatile than the other “transform” constraints. It allows you to map one type of transform properties (i.e. location, rotation or scale) of the target, to the same or another type of transform properties of the owner, within a given range of values (which might be different for each target and owner property). You can also switch between axes, and use the range values no more as limits, but rather as “markers” to define a mapping between input (target) and output (owner) values.

So, e.g. you can use the position of the target along the X axis to control the rotation of the owner around the Z axis, stating that **1 BU** along the target X axis corresponds to **10°** around the owner Z axis. Typical uses for this include gears (see note below), and rotation based on location setups.

About Gears

Unfortunately, this will not work for gears, as there are some underlying problems related to the math, which means that this cannot work nicely...

Options



Transformation panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Head/Tail

If a Bone is set as Target, a new field is displayed offering the optional choice where along this bone lays the target point.

Vertex Group

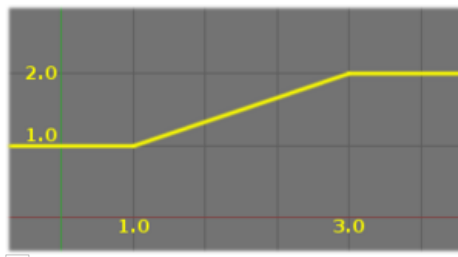
If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

Extrapolate

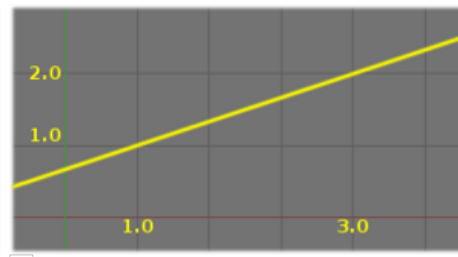
By default, the min and max values bound the input and output values, all values outside these ranges are clipped to them. When you enable this button, the min and max values are no more strict limits, but rather “markers” defining a proportional (linear) mapping between input and corresponding output values.

Let's illustrate that with two graphs (*The Extrapolate principles*). In these pictures, the input range (in abscissa) is set to **[1.0, 4.0]**, and its corresponding output range (in ordinate), to **[1.0, 2.0]**. The yellow curve represents the mapping between input and output.

The Extrapolate principles.



☐ Extrapolate disabled: the output values are bounded inside the [1.0, 2.0] range.



☐ Extrapolate enabled: the output values are "free" to proportionally follow the input ones.



Note that:

- When mapping transform properties to location (i.e. Loc Destination button is enabled), the owner's existing location is added to the result of evaluating this constraint (exactly as when the Offset button of the [Copy Location constraint](#) is enabled...).
- Conversely, when mapping transform properties to rotation or scale, the owner's existing rotation or scale is overridden by the result of evaluating this constraint.
- When using the rotation transform properties of the target as input, whatever are the real values, the constraint will always "take them back" into the $[-180^\circ, 180^\circ[$ range (e.g. if the target has a rotation of **420°** around its X axis, the values used as X input by the constraint will be $((420 + 180) \bmod 360) - 180 = 60^\circ \dots$). This is why this constraint is not really suited for gears!
- Similarly, when using the scale transform properties of the target as input, whatever are the real values, the constraint will always take their absolute values (i.e. invert negative ones).
- When a min value is higher than its corresponding max one, both are considered equal to the max one. This implies you cannot create "reversed" mappings...

Source

It contains the input (from target) settings.

The three Loc, Rot and Scale toggle buttons, mutually exclusive, allow you to select which type of property to use.

The X:, Y: and Z: min and max numeric fields control the lower and upper bounds of the input value range, independently for each axis. Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

Destination

It contains the output (to owner) settings.

- The three Loc, Rot and Scale toggle buttons, mutually exclusive, allow you to select which type of property to control.
- The three Axis Mapping drop-down lists allow you to select which input axis to map to respectively (from top to bottom) the X, Y and Z output (owner) axes.
- The min and max numeric fields control the lower and upper bounds of the output value range, independently for each mapped axis. Note that if a min value is higher than its corresponding max value, the constraint behaves as if it had the same value as the max one.

Space

This constraint allows you to chose in which space evaluate its owner's and target's transform properties.

Text

Clamp To Constraint

The paragraph that starts "The idea of a Clamp To constraint" --- should be reworded to "The idea of the Clamp To constraint"
The paragraph that starts "The idea of a Clamp To constraint" --- should remove "uses the time lpo" and replace with "uses the Evaluation Time" --- As the time ipo is no longer available.
The paragraph that starts "The dark side is that," --- should probably be reworded to "Unlike the Follow Path constraint, Clamp To constraint does not have an option to match the rotation (pitch, roll, yaw) of the targeted curve. As rotation is not always needed when following a curve the Clamp To constraint can be useful, especially since there are other ways to get rotation when it is needed."

Options > Target

The paragraph that starts "This constraint uses one target, which" --- This paragraph should probably mention explicitly what it is for. Probably reword to "The Target: field indicates which curve object the Clamp To constraint will track along. The Target: field must a curve object type. If this field is not filled in then it will be highlighted in red indicating that this constraint does not have all the information it needs to carry out its task and will therefore be ignored on the constraint stack."

Options > Cyclic

The paragraph that starts "By default, once the owner has" --- should be reworded

" By default, once the owner has reached one end of its target curve, it is stuck to it, if you continue to move it in the same direction. When the Cyclic option is enabled, as soon as it reaches one end of the curve, it is instantaneously moved to the other end.

This is of course primarily designed for closed curves (circles), as this allows your owner to go around it over and over. "

Proposed fixes: none

Clamp To Constraint

Description

The Clamp To constraint is a constraint which is particularly useful for moving things along large and complex paths which would otherwise be hard to hand-key smoothly.

The idea of a Clamp To constraint is very similar to the [Follow Path](#) constraint, with one main difference: where the last one uses the time lpo of the target curve, Clamp To will get the actual location properties of its owner (those shown in the Transform Properties panel, N), and judge where to put it by "mapping" this location along the target curve.

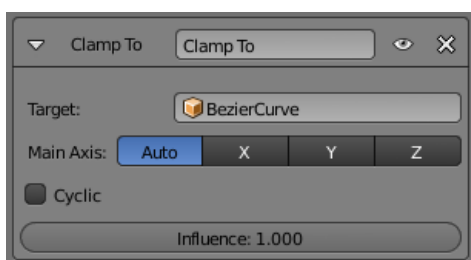
As with most things, of course, there's a bright side and a dark side.

The bright side is that when you are working with Clamp To, it will be easier to see what your owner will be doing, since you are working in the 3D view, it will just be a lot more precise than sliding keys around on a time lpo and playing the animation over and over.

The dark side is that, unlike in the [Follow Path constraint](#), Clamp To doesn't have any option to track your owner's rotation (pitch, roll, yaw) to the banking of the targeted curve, but you don't always need rotation on, so in cases like this it's usually a lot handier to fire up a Clamp To, and get the bits of rotation you do need some other way.

All together, what this means is that it will probably be much easier to animate varied motion across a curve than it might be if you were using Follow Path, but even if it's not easier, it's an interesting alternative, so it can just come down to personal choice.

Options



Clamp To panel

Target

This constraint uses one target, which *must be a curve object*, and is not functional (red state) when it has none.

Main Axis

This button group controls which global axis (X, Y or Z) is to be used as reference to position the owner along the target curve. There's no real wrong choice, so just pick the axis that would be easiest to work with, or that works best in your current situation. A good idea is picking the axis which the target curve is the longest along, so that the global and constrained locations of the object will be more similar to each other – or you can just use the default Auto option, and Blender will make its best guess.

Cyclic

By default, once the owner has reached one end of its target curve, it is stuck to it if you continue to move it in the same direction. When the Cyclic option is enabled, as soon as it reaches one end of the curve, it is instantaneously moved to its other end.

This is of course primarily designed for closed curves (circles & co), as this allows your owner to go around it over and over.

Text

Damped Track Constraint > Options > Target

One thing I notice that when Armature is used as a Target the tip tail field appears. I am beginning to think that when Target can be different Object Types we should have Target (Bone) Target (Mesh) etc so we can detail the different fields which may appear.

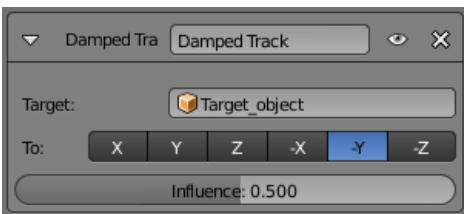
Proposed fixes: <http://wiki.blender.org/index.php/User:Terrywallwork/WorkingOn/Constraint-DampedTrack>

Damped Track Constraint

Description

The Damped Track constraint constrains one local axis of the owner to always point towards Target.

Options



☐ Damped Track panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

If Target is an Armature, a new field is displayed offering the optional choice to set an individual bone as Target.

Vertex Group

If Target is a Mesh, a new field is displayed offering the optional choice to set a Vertex Group as target.

To

The tracking local axis (Y by default), i.e. the owner's axis to point at the target. The negative options force the relevant axis to point away from the target.

Page status ([reviewing guidelines](#))

Text Seems ok

Proposed fixes: none

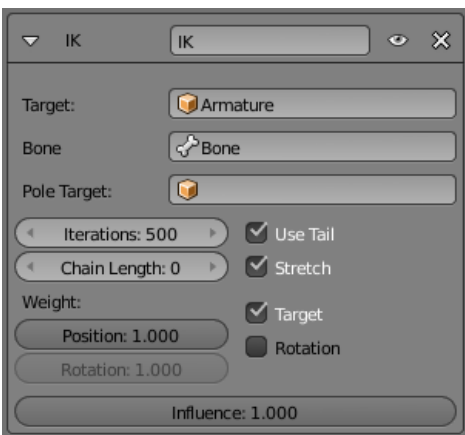
IK Solver Constraint

Description

The Inverse Kinematics constraint implements the *inverse kinematics* armature posing technique. Hence, it is only available for bones.

This constraint is fully documented in the [inverse kinematics page](#) of the rigging chapter.

Options



Inverse Kinematics panel

Target

Must be an armature

Bone

A bone in the armature

Pole Target

Object for pole rotation

Iterations

Maximum number of solving iterations

Chain Length

How many bones are included in the IK effect. Set to 0 to include all bones

Use Tail

Include bone's tail as last element in chain

Stretch

Enable IK stretching

Weight

Position

For Tree-IK: Weight of position control for this target

Rotation

Chain follow rotation of target

Target

Disable for targetless IK

Rotation

Chain follows rotation of target

Text Seems ok

Proposed fixes: none

Locked Track Constraint

Description

The Locked Track constraint is a bit tricky to explain, both graphically and textually. Basically, it is a [Track To constraint](#), but with a locked axis, i.e. an axis that cannot rotate (change its orientation). Hence, the owner can only track its target by rotating around this axis, and unless the target is in the plane perpendicular to the locked axis, and crossing the owner, this owner cannot really point at its target.

Let's take the best real world equivalent: a compass. It can rotate to point in the general direction of its target (the magnetic North, or a neighbor magnet), but it can't point *directly at it*, because it spins like a wheel on an axle. If a compass is sitting on a table and there is a magnet directly above it, the compass can't point to it. If we move the magnet more to one side of the compass, it still can't point *at* the target, but it can point in the general direction of the target, and still obey its restrictions of the axle.

When using a Locked Track constraint, you can think of the target as a magnet, and the owner as a compass. The Lock axis will function as the axle around which the owner spins, and the To axis will function as the compass' needle. Which axis does what is up to you!

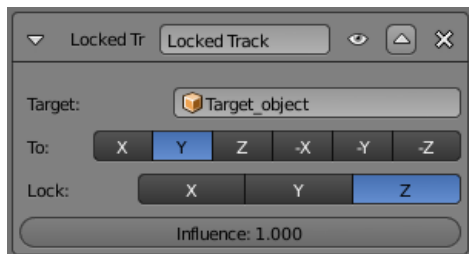
If you have trouble understanding the buttons of this constraint, read the tool-tips, they are pretty good. If you don't know where your object's axes are, turn on the Axis button in the Object menu's Draw panel. Or, if you're working with bones, turn on the Axes button in the Armature menu's Display panel.

This constraint was designed to work cooperatively with the Track To constraint. If you set the axes buttons right for these two constraints, Track To can be used to point the axle at a primary target, and Locked Track can spin the owner around that axle to a secondary target.

This constraints also works very well for 2D billboarding.

This is all related to the topic discussed at length in the [2.49 BSoD tracking tutorial](#).

Options



Locked track panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

To

The tracking local axis (Y by default), i.e. the owner's axis to point at the target. The negative options force the relevant axis to point away from the target.

Lock

The locked local axis (Z by default), i.e. the owner's axis which cannot be re-oriented to track the target.



If you chose the same axis for *To* and *Lock*, the constraint will be no more functional (red state).

Text Seems ok

Proposed fixes: none

Spline IK Constraint

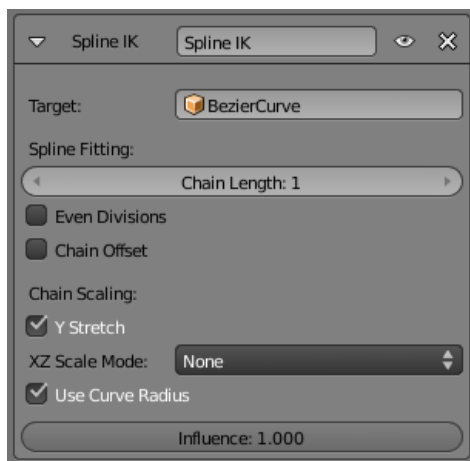
Description

The Spline IK constraint aligns a chain of bones along a curve. By leveraging the ease and flexibility of achieving aesthetically pleasing shapes offered by curves and the predictability and well integrated control offered by bones, Spline IK is an invaluable tool in the riggers' toolbox. It is particularly well suited for rigging flexible body parts such as tails, tentacles, and spines, as well as inorganic items such as ropes.

To setup Spline IK, it is necessary to have a chain of connected bones and a curve to constrain these bones to.

1. With the last bone in the chain selected, add a Spline IK constraint from the Bone Constraints tab in the Properties Editor.
2. Set the 'Chain Length' setting to the number of bones in the chain (starting from and including the selected bone) that should be influenced by the curve.
3. Finally, set Target to the curve that should control the curve.

Options



Spline IK panel

Target

The target curve

Spline Fitting

Chain Length

How many bones are included in the chain

Even Division

Ignore the relative length of the bones when fitting to the curve

Chain Offset

Offset the entire chain relative to the root joint

Chain Scaling

Y stretch

Stretch the Y axis of the bones to fit the curve

XZ Scale Mode

None

Don't scale the X and X axes (default)

Bone Original

Use the original scaling of the bones

Volume Preservation

Scale of the X and Z axes is the inverse of the Y scale

Use Curve Radius

Average radius of the endpoints is used to tweak the X and Z scaling of the bones, on top of the X and Z scale mode

See also

This subject is seen in depth in the [Rigging/Posing section](#).

- [Blender.org 2.56 Release Log for Spline IK](#)

Page status ([reviewing guidelines](#))

Text Reorganised and added a screenshot when Bone is used as a target

Proposed fixes: <http://wiki.blender.org/index.php/User:Terrywallwork/WorkingOn/Constraint-StretchTo>

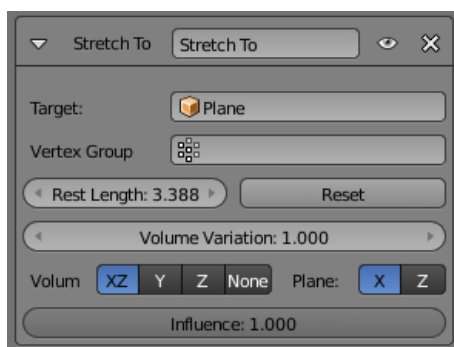
Stretch To Constraint

The Stretch To constraint causes its owner to rotate and scale its Y axis towards its target. So it has the same tracking behavior as the [Track To constraint](#). However, it assumes that the Y axis will be the tracking and stretching axis, and doesn't give you the option of using a different one.

It also optionally has some raw volumetric features, so the owner can squash down as the target moves closer, or thin out as the target moves farther away. Note however that it is not the real volume of the owner which is such preserved, but rather the virtual one defined by its scale values. Hence, this feature is working even with non-volumetric objects, like empties, 2D meshes or surfaces, curves.

With bones, the “volumetric” variation scales them along their own local axes (remember that the local Y axis of a bone is aligned with it, from root to tip).

Options



Stretch To panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Bone

When Target is an armature, a new field for a bone is displayed.

Head/Tail

When using a bone target, you can choose where along this bone lays the target point.

Vertex Group

When Target is a mesh, a new field is displayed where a vertex group can be selected.

Rest Length

This numeric field sets the rest distance between the owner and its target, i.e. the distance at which there is no deformation (stretching) of the owner.

Reset

When clicked, this small button will recalculate the Rest Length value, so that it corresponds to the actual distance between the owner and its target (i.e. the distance before this constraint is applied).

Volume Variation

This numeric field controls the amount of “volume” variation proportionally to the stretching amount. Note that the **0.0** value is not allowed, if you want to disable the volume feature, use the None button (see below).

Volume

These buttons control which of the X and/or Z axes should be affected (scaled up/down) to preserve the virtual volume while stretching along the Y axis.

If you enable the NONE button, the volumetric features are disabled.

Plane

These buttons are equivalent to the *Up* ones of the [Track To constraint](#): they control which of the X or Z axes should be maintained (as much as possible) aligned with the global Z axis, while tracking the target with the Y axis.

Track To Constraint

Description

The Track To constraint applies rotations to its owner, so that it always points a given “To” axis towards its target, with another “Up” axis permanently maintained as much aligned with the global Z axis (by default) as possible. This tracking is similar to the “billboard tracking” in 3D (see note below).

This is the preferred tracking constraint, as it has a more easily controlled constraining mechanism.

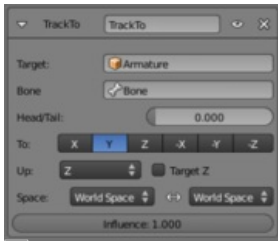
This constraint shares a close relationship to the [Inverse Kinematics constraint](#) in some ways. It is very important in rig design, and you should be sure to read and understand the [2.49 BSoD tracking tutorial](#), as it centers around the use of both of these constraints.



Billboard tracking

The term “billboard” has a specific meaning in real-time CG programming (i.e. video games!), where it is used for plane objects always facing the camera (they are indeed “trackers”, the camera being their “target”). Their main usage is as support for tree or mist textures: if they were not permanently facing the camera, you would often see your trees squeezing to nothing, or your mist turning into a millefeuille paste, which would be funny but not so credible.

Options



Track To panel

Targets

This constraint uses one target, and is not functional (red state) when it has none.

Bone

When Target is an armature, a new field for a bone is displayed.

Head/Tail

When using a bone target, you can choose where along this bone lays the target point.

Vertex Group

When Target is a mesh, a new field is displayed where a vertex group can be selected.

To

The tracking local axis (Y by default), i.e. the owner’s axis to point at the target. The negative options force the relevant axis to point away from the target.

Up

The “upward-most” local axis (Z by default), i.e. the owner’s axis to be aligned (as much as possible) with the global Z axis (or target Z axis, when the Target button is enabled).

Target Z

By default, the owner’s Up axis is (as much as possible) aligned with the global Z axis, during the tracking rotations. When this button is enabled, the Up axis will be (as much as possible) aligned with the target’s local Z axis...

Space

This constraint allows you to choose in which space evaluate its owner’s and target’s transform properties.



If you choose the same axis for To and Up, the constraint will be no more functional (red state).

Page status ([reviewing guidelines](#))

Text

Action Constraint > Description

Paragraphs need a rewrite to be clearer, also needs to give examples, rather than just saying try them out and see what they do.

Options

Image for action constraint it laid out different in newer versions of Blender and slightly different field names. Needs correction. Also there are different option when using normal objects and an armature.

Notes

This section is a mess. Unclear. A lot of this should be reworded.

Proposed fixes: none

Action Constraint

Description

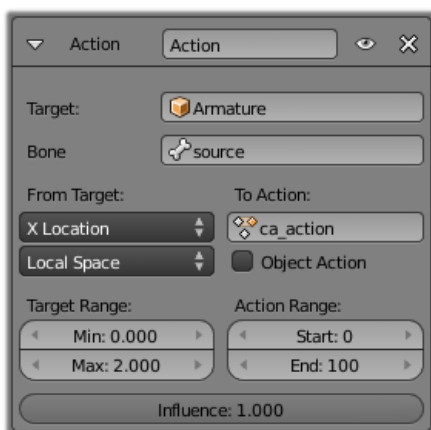
The Action constraint is a quite powerful one, but also a bit tricky to understand. Basically, it allows you to map an action on the owner, using one transform property of the target to control where (or rather, when) in the action the owner lays.

Yes, I know, this is not very clear. First of all, you should know what is an [action](#) in Blender, else follow the link... And for those who know them, the underlying idea of the Action constraint is very similar to the one behind the [lpo drivers](#), except that the former uses a whole action (i.e. a bunch a lpo curves of the same type), when the later control a single lpo curve of their "owner"...

Note that even if the constraint accepts the Mesh action type, only the Object, Pose and Constraint types are really working, as constraints can only affect objects or bones transform properties, and not meshes' shapes...

As an example, let's assume you have defined an Object action (it can be assigned to any object, or even no object at all), and have mapped it on your owner through an Action constraint, so that moving the target in the $[0.0, 2.0]$ range along its X axis, maps the action content on the owner, in the $[0, 100]$ frame range. This will mean that when the target's X property is **0.0**, the owner will be as if in frame **0** of the linked action; with the target's X property at **1.0**, the owner will be as if in frame **50** of the linked action, etc.

Options



Action panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Transfrom Channel

This drop-down list controls which transform property (location, rotation or scale along/around one of its axes) from the target to use as "action driver".

Target Space

This constraint allows you to chose in which space to evaluate its target's transform properties.

Action

Select the name of the action you want to use.



Even though it might not be in red state (UI refresh problems...), this constraint is obviously not functional when this field does not contain a valid action.

Object Action

Bones only, when enabled, this option will make the constrained bone use the “object” part of the linked action, instead of the “same-named pose” part. It allows you to apply the action of an object to a bone.

Target Range Min/Max

The lower and upper bounds of the driving transform property value.

By default, both values are set to **0.0**



Unfortunately, here again we find the constraints limitations:

- When using a rotation property as “driver”, these values are “mapped back” to the $[-180.0^\circ, 180.0^\circ]$ range.
- When using a scale property as “driver”, these values are limited to null or positive values.

Action Range Start/End

The starting and ending frames of the action to be mapped

Note that:

- These values must be strictly positive.
- By default, both values are set to **0**, which disable the mapping (i.e. the owner just get the properties defined at frame **0** of the linked action...).

Notes

- When the linked action affects some location properties, the owner’s existing location is added to the result of evaluating this constraint (exactly as when the Offset button of the [Copy Location constraint](#) is enabled...).
- When the linked action affects some scale properties, the owner’s existing scale is multiplied with the result of evaluating this constraint.
- When the linked action affects some rotation properties, the owner’s existing rotation is overridden by the result of evaluating this constraint.
- Unlike usual, you do can have a Start value higher than the End one, or a Min one higher than a Max one: this will revert the mapping of the action (i.e. it will be “played” reversed...), unless you have both sets reverted, obviously!
- When using a Constraint action, it is the constraint *channel’s names* that are used to determine to which constraints of the owner apply the action. E.g. if you have a constraint channel named “trackto_empty1”, its keyed Influence and/or Head/Tail values (the only ones you can key) will be mapped to the ones of the owner’s constraint named “trackto_empty1”.
- Similarly, when using a Pose action (which is obviously only meaningful and working when constraining a bone!), it is the bone’s name that is used to determine which bone *channel’s names* from the action to use (e.g. if the constrained bone is named “arm”, it will use and only use the action’s bone channel named “arm”...). Unfortunately, using a Pose action on a whole armature object (to affect all the keyed bones in the action at once) won’t work...
- Note also that you can use the [pose library feature](#) to create/edit a Pose action datablock... just remember that in this situation, there’s one pose per frame!

Text

Child Of Constraint > Description

Paragraph that starts "You can have several different parents" --- "for a same object" should read "for the same object"

Paragraph that starts "As with any constraint, you can key (i.e. animate) its Influence" should probably be rewritten as "As with any constraint, you can key (i.e. animate) its Influence setting. This allows the object which has a Child Of constraint upon it to change overtime which target object will be considered the parent, and therefore have influence over the Child Of constrained object."

Paragraph that starts "Don't confuse this "basic" --- "You do can use" should read "You can use". --- Not sure if the bit about object skinning is even needed as I am not sure this has anything to do with that.

Child Of Constraint > Options > Target

The paragraph on target does not mention what it is actually for.

Child Of Constraint > Options > Location, Rotation, Scale XYZ

Each of these field should probably say that selecting/deselecting any of the axis fields will control weather the target object affects the child.

Child Of Constraint > Tips

Paragraph that starts "When creating a new" --- "to click on the Set Offset button" should be "to click on the Set Inverse button"

Paragraph that starts "About the toggle buttons that" --- "or to disable the whole three ones" should be "or to disable all three of the given Location, Rotation or Scale transforms."

Paragraph that starts "If you use this constraint with all channels on," --- This paragraph is technical mumbojumbo. Needs to be made understandable.

Example

The Images are using the old 2.4x series of Blender they need to be updated to Blender 2.6x series.

Proposed fixes: none

Child Of Constraint

Description

Child Of is the constraint version of the standard parent/children relationship between objects (the one established through the CtrlP shortcut, in the 3D views).

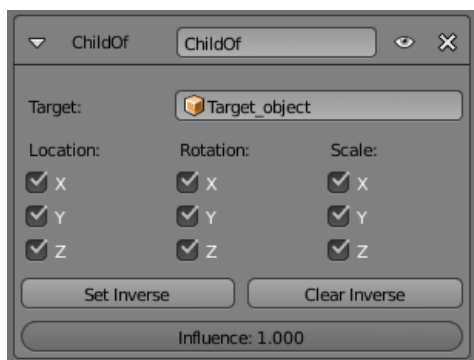
Parenting with a constraint has several advantages and enhancements, compared to the traditional method:

- You can have several different parents for a same object (weighting their respective influence with the... Influence slider).
- As with any constraint, you can key (i.e. animate) its Influence setting, and hence e.g. have your owner fully parented to a first object at start, and to another object at end of the animation.



Don't confuse this "basic" object parenting, with the one that defines the [chains of bones](#) inside of an armature. You *do* can use this constraint to parent an object to a bone (the so-called "[object skinning](#)"), or even bones to bones. But don't try to use it to define chains of bones.

Options



Child Of panel

Target

This constraint uses one target, and is not functional (red state) when it has none. If Target is an armature or a mesh, a new name field appears where a name of a Bone or a Vertex Group can be selected.

Location X, Y, Z

Each of these buttons will make the parent affect the location along the corresponding axis.

Rotation X, Y, Z

Each of these buttons will make the parent affect the rotation around the corresponding axis.

Scale X, Y, Z

Each of these buttons will make the parent affect the scale along the corresponding axis.

Set Inverse

By default, when you parent your owner to your target, the target becomes the origin of the owner's space. This means that the location, rotation and scale of the owner are offset by the same properties of the target. In other words, the owner is transformed when you parent it to your target.

This might not be desired! So, if you want to restore your owner in its before-parenting state, click on the Set Inverse button.

Clear Inverse

This button reverses (cancels) the effects of the above one, restoring the owner/child to its default state regarding its target/parent.

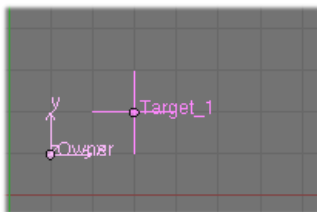
Tips

When creating a new parent relationship using this constraint, it is usually necessary to click on the Set Offset button after assigning the parent. As said above, this cancels out any unwanted transform from the parent, so that the owner returns to the location/rotation/scale it was in before the constraint was applied. Note that you should apply Set Inverse with all other constraints disabled (their Influence set to **0.0**) for a particular Child Of constraint, and before transforming the target/parent (see example below).

About the toggle buttons that control which target's (i.e. parent's) individual transform properties affect the owner, it is usually best to leave them all enabled, or to disable the whole three ones for a given transform.

If you use this constraint with all channels on, it will use a straight matrix multiplication for the parent relationship, not decomposing the parent matrix into loc/rot/siz. This ensures any transformation correctly gets applied, also for combinations of rotated and non-uniform scaled parents.

Example



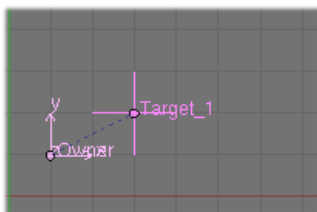
1. No constraint

Note the position of `Owner` empty – **1.0 BU** along X and Y axes.



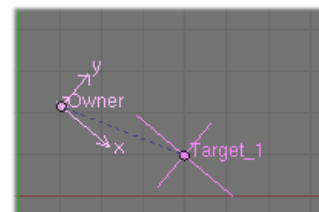
2. Child Of just added

Here you can see that `Owner` empty is now **1.0 BU** away from `Target_1` empty along X and Y axes.



3. Offset set

Set Inverse has been clicked, and `Owner` is back to its original position.



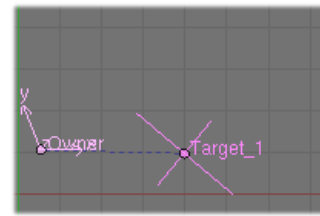
4. Target/parent transformed

`Target_1` has been translated in the XY plane, rotated around the Z axis, and scaled along its *local* X axis.



5. Offset cleared

Clear Inverse has been clicked – *Owner* is fully again controlled by *Target_1*.



6. Offset set again

Set Offset has been clicked again. As you can see, it *does not* give the same result as in (Target/parent transformed). As said above, use *Set Inverse* only once, before transforming your target/parent.

Text This chapter seems fine.

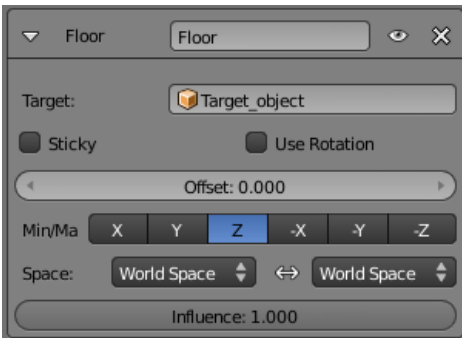
Proposed fixes: none

Floor Constraint

Description

The Floor constraint allows you to use its target position (and optionally rotation) to specify a plane with a “forbidden side”, where the owner cannot go. This plane can have any orientation you like. In other words, it creates a floor (or a ceiling, or a wall.)!

Options



Floor panel

Targets

This constraint uses one target, and is not functional (red state) when it has none.

Bone

When Target is an armature, a new field for a bone is displayed.

Vertex Group

When Target is a mesh, a new field is display where a vertex group can be selected.

Sticky

This button makes the owner immovable when touching the “floor” plane (it cannot slide around on the surface of the plane any more). This is fantastic for making walk and run animations!

Use Rotation

This button forces the constraint to take the target’s rotation into account. This allows you to have a “floor” plane of any orientation you like, not just the global XY, XZ and YZ ones...

Offset

This numeric fields allows you to offset the “floor” plane from the target’s center, of the given number of Blender Units. Use it e.g. to account for the distance from a foot bone to the surface of the foot’s mesh.

Max/Min

This set of (mutually exclusive) buttons controls which plane will be the “floor”. The buttons’ names correspond indeed to the *normal* to this plane (e.g. enabling Z means “XY plane”, etc.)

By default, these normals are aligned with the *global* axes. However, if you enable Use Rotation (see above), they will be aligned with the *local target’s axes*.

As the constraints does not only define an uncrossable plane, but also a side of it which is forbidden to the owner, you can chose which side by enabling either the positive or negative normal axis... E.g, by default (Z), the owner is stuck in the positive Z coordinates.

Space

This constraint allows you to chose in which space evaluate its owner’s and target’s transform properties.

Text

Follow Path Constraint > Description

Paragraph that starts "The Follow Path constraint places its owner onto" --- "and make it move along" should be "and makes it move along"

Paragraph that starts "Its location (as shown in" --- "is used as offset" should be "is used as an offset"

Paragraph that starts "The most simple is to define the" --- should probably be reworded to "The most simple is to define the number of frames of the movement, in the Path Animation panel of the Object Data context, via the numeric field Frames, and its start frame via the constraint's Offset option (by default, start frame: 1 [= offset of 0]), duration: 100)"

The paragraph that starts "The second way – much more precise and powerful – is to define a Speed interpolation" --- is now longer correct as we don't have Speed Curves in 2.6 but Evaluation Time in the Curve Object Data Context.

The paragraph that starts "If you don't want you owner" --- Is no longer true for 2.6

The paragraph that starts "Note that you also need to keyframe Evaluation Time for the Path" --- Probably needs to use the Note template or Icon.

The paragraph that starts "Objects scale by the curve radius" --- should probably link to the curve radius info.

Proposed fixes: none

Follow Path Constraint

Description

The Follow Path constraint places its owner onto a *curve* target object, and make it move along this curve (or path). It can also affect its owner's rotation to follow the curve's bends, when the Follow Curve option is enabled.

The owner is always evaluated in the global (world) space:

- Its location (as shown in the Transform Properties panel, N) is used as offset from its normal position on the path. E.g. if you have an owner with the (1.0, 1.0, 0.0) location, it will be one BU away from its normal position on the curve, along the X and Y axis. Hence, if you want your owner *on* its target path, clear its location (AltG)!
- This location offset is also proportionally affected by the *scale of the target curve*. Taking the same (1.0, 1.0, 0.0) offset as above, if the curve has a scale of (2.0, 1.0, 1.0), the owner will be offset of *two* BU along the X axis (and one along the Y one) ...
- When the Curve Follow option is enabled, its rotation is also offset to the one given by the curve (i.e. if you want the Y axis of your object to be aligned with the curve's direction, it must be, in rest, non-constrained state, aligned with the global Y axis). Here again, clearing your owner's rotation (AltR) might be useful...

The movement of the owner along the target curve/path might be controlled in two different ways:

- The most simple is to define the number of frames of the movement, in the Path Animation panel in the curve's Curve menu, *via* the numeric field Frames, and its start frame *via* the constraint's Offset option (by default, start frame: 1 [= offset of 0]), duration: 100).
- The second way – much more precise and powerful – is to define a Speed interpolation curve for the Target path (in the Graph Editor, ⇧ ShiftF6). The start position along the path will correspond to an lpo value of 0.0, and the end position, to an lpo value of 1.0. You can therefore control the start frame, the speed of the movement, the end frame, and even force your object to go forth and back along the path! See the [animation chapter](#) to learn more about lpo curves.
- If you don't want your owner to move along the path, you can give to the target curve a flat Speed lpo (its value will control the position of the owner along the path).

Follow Path is another constraint that works well with the [Locked Track one](#). One example is a flying camera on a path. To control the camera's roll angle, you can use a Locked Track and a target object to specify the up direction, as the camera flies along the path.

Follow Path and Clamp To

Do not confuse these two constraints. Both of them constraint the location of their owner along a curve, but Follow Path is an "animation-only" constraint, inasmuch that the position of the owner along the curve is determined by the time (i.e. current frame), whereas the [Clamp To](#) constraint determines the position of its owner along the curve using one of its location properties' values.

Note that you also need to keyframe Evaluation Time for the Path. Select the path, go to the path properties, set the overall frame to the first frame of the path (eg frame 1), set the value of Evaluation time to the first frame of the path (eg 1), right click on Evaluation time, select create keyframe, set the overall frame to the last frame of the path (eg frame 100), set the value of Evaluation time to the last frame of the path (eg 100), right click on Evaluation time, select create keyframe.

Options



Follow Path panel

Target

This constraint uses one target, which *must be a curve object*, and is not functional (red state) when it has none.

Curve Radius

Objects scale by the curve radius

Fixed Position

Object will stay locked to a single point somewhere along the length of the curve regardless of time

Offset

The number of frames to offset from the “animation” defined by the path (by default, from frame **1**).

Follow Curve

If this option is not activated, the owner’s rotation isn’t modified by the curve; otherwise, it’s affected depending on the following options:

Forward

The axis of the object that has to be aligned with the forward direction of the path (i.e. tangent to the curve at the owner’s position).

Up

The axis of the object that has to be aligned (as much as possible) with the world Z axis.

In fact, with this option activated, the behavior of the owner shares some properties with the one caused by a [Locked Track constraint](#), with the path as “axle”, and the world Z axis as “magnet”.

Text This needs a complete rewrite, because we should not be using BA thread and video to explain something in the manual. It's ok as a extra but not at the main way to describe a feature.

Proposed fixes: none

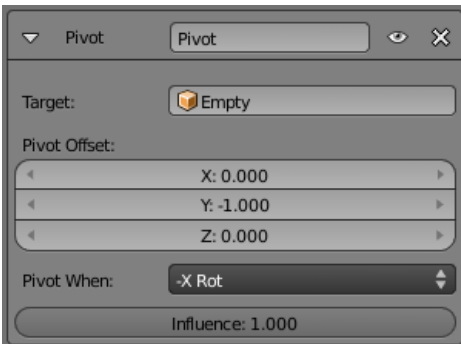
Pivot Constraint

Description

The Pivot constraint allows the owner to rotate around a target object.

It was originally intended for foot rigs.

Options



Pivot panel

Target

The object to be used as a pivot point

Bone

When Target is an armature, a new field for a bone is displayed.

Head/Tail

When using a bone target, you can chose where along this bone lays the target point.

Vertex Group

When Target is a mesh, a new field is display where a vertex group can be selected.

Pivot Offset

Offset of pivot from target

Pivot When

Always, Z Rot, Y Rot, ...

Example

See also

- [Blender Artists Forum: *Head-Tail pivot Constrain proposal \(with Video and .blend\)*](#), the thread where the constraint was first proposed

Page status ([reviewing guidelines](#))

Text

Complete rewrite needed. Unclear and Child object field not explained what it does.

Proposed fixes: none

Rigid Body Joint Constraint

Description

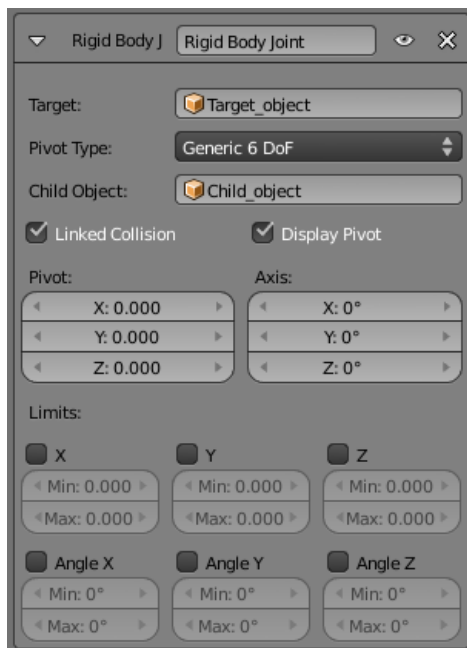
The Rigid Body Joint constraint is very special. Basically, it is used by the physical part of the Blender Game Engine to simulate a joint between its owner and its target. It offers four joint types: hinge type, ball-and-socket type, cone-twist, and generic six-DoF (degrees of freedom) type.

The joint point and axes are defined and fixed relative to the owner. The target moves as if it were stuck to the center point of a stick, the other end of the stick rotating around the joint/pivot point...

This constraint is of no use in most "standard" static or animated projects. However, you can use its results outside of the BGE, through the Game » Record Animation menu entry (from the main menu of the User Preferences window, see [Rigid Bodies](#) for more info on this topic).

For a demo file that shows some of the different types, see: [BGE-Physics-RigidBodyJoints.blend](#).

Options



Rigid Body Joint panel

Target

This constraint uses one target, and is not functional (red state) when it has none.

Joint Type

Ball

works like an ideal ball-and-socket joint, i.e. allows rotations around all axes like a shoulder joint.

Hinge

works in one plane, like an elbow: the owner and target can only rotate around the X axis of the pivot (joint point).

Limits

Angular limits for the X axis

Cone Twist

similar to Ball, this is a point to point joint with limits added for the cone and twist axis

Limits

Angular limits

Generic 6DOF

works as the *Ball* option, but the target is no more constrained at a fixed distance from the pivot point, by default (hence the six degrees of freedom: rotation and translation around/along the three axes).

In fact, there is no more joint by default, with this option, but it enables additional settings which allow you to restrict some of these DoF:

Limits

Linear and angular limits for a given axis (of the pivot) in Blender Units and degrees respectively.

Child Object

normally, leave this blank. You can reset it to blank by right clicking and selecting Reset to Default Value.

Linked Collision

When enabled, this will disable the collision detection between the owner and the target (in the physical engine of the BGE).

Display Pivot

When enabled, this will draw the pivot of the joint, in the 3D views. Most useful, especially with the Generic 6DOF joint type!

Pivot

These three numeric fields allow you to relocate the pivot point, *in the owner's space*.

Axis

These three numeric fields allow you to rotate the pivot point, *in the owner's space*.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Constraints/Relationship/Script>"

Doc:2.6/Manual

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- [2.49 Python API \(external link\)](#)
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Text

Shrinkwrap Constraint > Description

The Paragraph that start "The Shrinkwrap constraint is the" --- should probably be reworded "The Shrinkwrap constraint is the "object counterpart" of the Shrinkwrap modifier. It moves the ownder origin and therefore the owner object's location to the surface of its target."

The paragraph that starts "This implies that the target" --- I am not sure but I don't think this is correct anymore "Hence, the Shrinkwrap option is only shown in the Add Constraint to Active Object menu, CtrlAltC, (or its bone's equivalent), when the selected inactive object is a mesh."

Proposed fixes: none

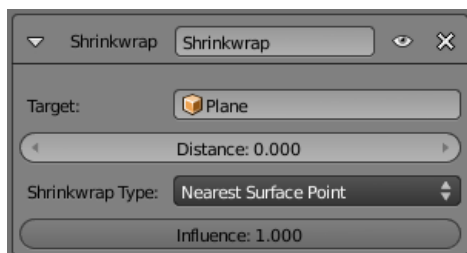
Shrinkwrap Constraint

Description

The Shrinkwrap constraint is the "object counterpart" of the [Shrinkwrap modifier](#). It shrinks its owner's location to the *surface* of its target.

This implies that the target *must* have a surface. In fact, the constraint is even more selective, as it can only use meshes as targets. Hence, the *Shrinkwrap* option is only shown in the *Add Constraint to Active Object* menu, CtrlAltC, (or its bone's equivalent), when the selected inactive object is a mesh.

Options



Shrinkwrap panel

Target

This constraint uses one target, which *must be a mesh object*, and is not functional (red state) when it has none.

Distance

This numeric field controls the offset of the owner from the shrunk computed position on the target's surface.

Positive values places the owner "outside" of the target, and negative ones, "inside" the target.

This offset is applied along the straight line defined by the original (i.e. before constraint) position of the owner, and the computed one on the target's surface.

Shrinkwrap Type

This drop-down list allows you to select which method to use to compute the point on the target's surface to which translate the owner's center. You have three options:

Nearest Surface Point

The chosen target's surface's point will be the nearest one from the original owner's location. This is the default and most commonly useful option.

Projection

The target's surface's point is determined by projecting the owner's center along a given axis.

This axis is controlled by the three X, Y and Z toggle buttons that show up when you select this type. This mean the projection axis can only be aligned with one of the global axes, median to both of them (XY, XZ or YZ), or to the three ones (XYZ).

When the projection of the owner's center along the selected direction does not hit the target's surface, the owner's location is let unchanged.

Nearest Vertex

This method is very similar to the *Nearest Surface Point* one, except that the owner's possible shrink locations are limited to the target's vertices.

Animation

Animation is making an object move or change shape over time. Objects can be animated in many ways:

Moving as a whole object

Changing their position, orientation or size in time;

Deforming them

animating their vertices or control points;

Character Animation via Armature

animated to deform by the movement of bones inside the mesh, a very complex and flexible interaction that makes character-shaped objects appear to walk and jump.

In this chapter we will cover the first two, but the basics given here are actually vital for understanding the following chapters as well.

Three methods are normally used in animation software to make a 3D object move:

Key frames

Complete positions are saved for units of time (frames). An animation is created by interpolating an object fluidly through the frames. The advantage of this method is that it allows you to work with clearly visualized units. The animator can work from one position to the next and can change previously created positions, or move them in time.

Animation Curves

Curves are interpolated from keyframes, and can be drawn for each XYZ component for location, rotation, and size, as well as any other attribute in Blender. These form the graphs for the movement, with time set out horizontally and the value set out vertically. The advantage of this method is that it gives you precise control over the results of the movement.

Path

A curve is drawn in 3D space, and the Object is constrained to follow it according to a given time function of the position along the path.

The first two systems in Blender are completely integrated in a single one, the [F-Curve system](#).

In Blender 2.5x, everything can now be animated. Previously, only certain datablocks had the ability to be keyframed. Now users have the ability to animate nearly any type of data that can be changed to multiple values.

Chapters

General Principles and Tools

- [Keyframes](#)
- [Animation Editors](#)
- [Using The Timeline](#)
- [Markers](#)

The Graph Editor

- [Using the Graph Editor](#)
- [F-Curves](#)
- [Editing Curves](#)
- [F-Curve Modifiers](#)

The Action Editor

- [Actions](#)
- [Creating Actions](#)

Animation Techniques

- [Constraints](#)
- [Moving objects on a Path](#)
- [Changing Object Layers](#)
- [Game Engine Physics Recording](#)

Animating Deformation

- [Methods of deformation](#)
- [Shape Keys](#)
- [Absolute Shape Keys](#)
- [Deforming by a Lattice](#)
- [Deforming with Hooks](#)

See also [Hooks](#) - Uses a modifier as a way to change the shape of a mesh. Sorta like sticking a fish hook in a mesh and pulling. Uses the principles discussed in Shape Keys.

Drivers

- [Drivers](#)

[Driven Shape Keys](#)

The [BSoD Introduction to Character Animation tutorial](#) is a good starting point for learning character animation. Even if you never used Blender before.

Page status ([reviewing guidelines](#))

Images

Images from 2.4

Proposed fixes: none

The Timeline

The *Timeline* window, identified by a clock icon, is shown by default at the bottom of the screen.


The timeline is not really an “editor”, but more like the *Outliner* window, an “informational” window, with a few and limited editing features.

Here you can have an overview of the animation part of your scene: what is the current time, either in frames or in seconds, where are the keyframes of the active object, what are the start and end frames of your animation, markers, etc...

It has VTR-like controls, to playback the animation, change the current frame and frame range, scroll between the keyframes ("VTR" stands for **V**ideo **T**ape **R**ecorder) .

Timeline Elements

The current frame

The current frame is materialized by the thick green vertical line (the so-called “time cursor”, in *Timeline window*, it is at frame **100**). You can move it by clicking LMB  anywhere in the window, and you can even scroll forth and back the animation by clicking and dragging with this same mouse button. The actual frame number (or second value) is drawn near the pointer when you click or drag the time cursor – and obviously, it is always in the “current frame” numeric field of the [header](#).

Keyframes

Some keyframes of the active object (or active [Doc:2.5/Manual/Animation/Keyframes](#), etc.) are materialized by vertical colored lines at the frame they occur. I think only three different lpo types are drawn this way:

- **yellow**

Non-action *Object* keys (location, rotation, etc.)

- **orange**

Material keys (diffuse/specular/mirror colors, etc.)

- **dark cyan**

keys forming [actions](#) (always pose of armature’s bones, but also possibly objects’ and shapes’ lpos)

Note

Some lpo type keys aren’t materialized at all (e.g. *Texture* or *Constraint* ones).

In [\(Timeline window\)](#), we have two “object” keyframes (frames **10** and **150**), one “material” keyframe (frame **40**), and no “action” keyframe.

Markers

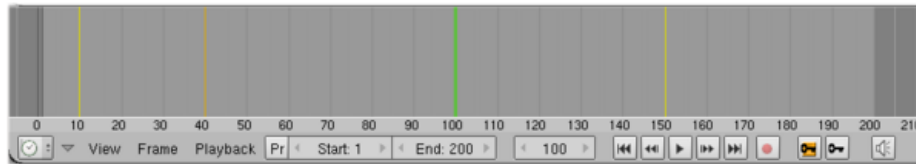
[Markers](#) are materialized as small triangles, with their name near them.

Color codes are:

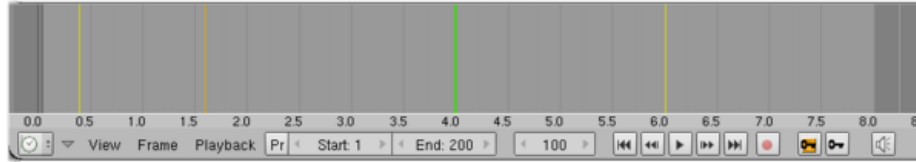
- **white line, black text:** unselected markers
- **yellow line, white text:** selected markers

Adjusting the View

Timeline window.






Frames display.



Seconds display.

This window is unidimensional – it only represents the time in your scene, along its horizontal axis. As frames are the fundamental unit of time in Blender, the timeline displays by default frame numbers, at its bottom.

The animation range is materialized by the lighter shade of gray (in *Timeline window*, from frame **1** to frame **200**).

This window behaves as any “area” in Blender: you can pan it with MMB  click-and-drag (left/right only, as this is an unidimensional window...), zoom in/out with Ctrl MMB  or Wheel , etc.

View Menu

This menu controls what you see and how you see it:

Maximize Window(CtrlArrowup)

This standard command makes this window full-screen. When it is maximized, this entry turns to *Tile Window*, to restore it to its previous size (CtrlArrowdown).

Lock Time to Other Windows

This is a cross-windows feature concerning all “time” windows (i.e. all windows which represent the time along their X axis). All these windows that have this option enabled will always show the same “time range”. When you modify it in one window (either by panning or scaling along its X axis), all the others are immediately updated.

ViewAll(⇧ Home)

This standard command will horizontally zoom the display to show the whole animation range (as defined by the *Start* and *End* frames).

Center View(C)

This standard command will center the display on the current frame.

Jump to Prev Key (CtrlPageDown)

Jump to Next Key (CtrlPageUp)

These commands will make the cursor jump the the nearest previous or next keyframe of the active object.

Jump to Prev Marker (PageDown)

Jump to Next Marker (PageUp)

These commands will make the cursor jump the the nearest previous or next [marker](#).

Only Selected Data Keys

I think that when this is enabled, the *Timeline* should only draw the selected keyframes... But actually, it seems to always draw the keyframes of the active element!

ShowSeconds/Literal/ShowFrames (T)

By default, the time is materialized as frames, as it is internally in Blender. This menu entry enables you to rather show the time in seconds (based on the frames per second setting of the scene).

Very often storyboards are laid out in seconds. Choosing this display unit makes things a little easier than doing all that multiplying in your head.

Play Back Animation

Plays the animation from the current frame to end, and then cycling from start to end until you click the pause button (or hit Esc). All windows matching the criteria set in the *Playback* menu (see below) will display the animation.

Editing

Frame Menu

This menu concerns mainly the [markers topic](#), with two other useful options:

Set as End (E)

Set as Start (S)

Well, as you might have guessed, these two commands respectively set the current frame to be the start or end frame of your animation...

Playback

Playback Menu

This menu controls how the animation is played back, and where.

Continue Physics

The tool tip says: "During playback, continue physics simulations regardless of the frame number". Don't understand what it means...

Set Frames/Sec – This will pop-up a numeric field where you can specify a new fps setting.

Note: Remember the warning of the [introduction](#) about modifying this setting after having created some animations – it will speed up/down all existing ones...

Sync Playback to Frames/Sec

When enabled, it will force the playback to synchronize with the expected frame rate.

Note that when Blender has enough power to compute more frames per second than needed, it will stick to the specified frame rate. So this setting has only an effect when the animations are too heavy to be computed in real time: by default, Blender will render all frames, effectively slowing down the playback. With this option enabled, it will drop (i.e. not compute them) as much frames as necessary to keep the normal playback rate.

See also the "sync audio" button of the header, [below](#).

The other options concerns what type of windows should be included in the playback initiated by this *Timeline* window. Obviously, the more windows are involved, the more CPU power you'll need...

Sequencer Windows

When this option is set, all the *Video Sequence Editor* windows are included in the playback (whatever is there "display" mode: *Sequence* or one of the preview ones...).

See also the "sync audio" button of the header, [below](#).

Image Windows

When this option is set, all the *UV/Image Editor* windows are included in the playback.

Buttons Windows

When this option is set, all the *Buttons Windows* are included in the playback (this allows you to see the evolutions of the values of the animated settings).

Animation Windows

When this option is set, all the animation windows (i.e. the *Ipo Curve Editor*, *Action Editor* and *NLA Editor* ones) are included in the playback.

All 3D Windows

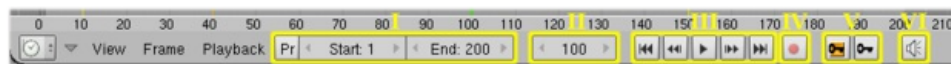
When this option is set, all the *3D View* windows are included in the playback.

Top-Left 3D Window

When this option is set, only the top-left-most *3D View* window is included in the playback.

Header Controls

The header controls mostly mimic VTR ones:



The header of the *Timeline* window.

(I) *The animation range*

The first three controls concern the start and end frames of animation.

Start/End

The start and end frames! See also the *Set as Start/Set as End* entries of the [Frame menu](#) above.

Pr

Short for "Playback Range". This parameter is specified by *Start/End*, and are "linked" to the ones set in the *Anim* panel of the *Scene* context, *Render* sub-context (F10) – they are the same values. However, when you enable this *Pr* button, you can specify a new, temporary animation range, only available/effective for the realtime playbacks (initiated by the "play" button of the timeline, or the AltA shortcut). This is much useful when you have to work on a small piece of a big (long) animation!

(II) *The current frame*

The third numeric field displays, and allows you to modify, the current frame (as materialized by the green line cursor).

(III) *VTR buttons*

These five buttons allow you to navigate in your animation.

The center "play" button

Start the playback! When playing, it turns to a "pause" one, which... pauses (or stops) the playback.

The first and last buttons

respectively, send you to the start and end frame.

The other two

respectively send you to the previous/next shown keyframe.

(IV) *Automation*

The "record" red-dot button enables something often called as "automation": it will add and/or replace existing keyframes of the active object when you transform it in a 3D view. Note that this work even during playback – the playback is just suspended during the transformations, and resumed once you have validated them.

When you enable this option, another drop-down *Auto-Keying Mode* list appears to its right, controlling the automation mode:

Replace Keys

This will only replace existing keyframes, never add new ones. Hence, your transformations will only have an effect when you do them at an already keyed frame.

Add/Replace Keys

This will replace existing keyframes, if any, or add new ones.

You'll find the same options (*Auto-Keying Enabled* button, which should be equivalent to the "record" one, and the *Auto-Keying Mode* drop-down list) in the *Edit Methods* tab of the *User Preferences* window. However, these ones seem to have no effect! But just below them, in the same *User Preferences* window, you have three toggle buttons that control which curves are automatically keyed by this tool:

Available

will add a key to all already existing lpo curves.

Needed

will add keys only when needed (i.e. only to lpo curves controlling properties that are changing).

Use Visual Keying

This is to be used with objects or bones that have certain constraints that can affect the key values. For example, setting a key on an object with a *Copy Location* constraint would normally set the key for it's unconstrained location. Enabling this option causes the key to be set for the constrained location.

Note that automation only works for transform properties (objects and bones), in the 3D views (i.e. you can't use it e.g. to animate the colors of a material in the *Buttons* window...).

(V) *Inserting and deleting keys*

The two "key" buttons allow you to insert (I) (orange background) or delete (AltI) the keys of the active object defined for the current frame.

This is not an easy-to-understand nor to-use feature! It tries to use the "context of the largest area" (an "area" is a Blender's window). E.g if your largest window is an *lpo Curve Editor* in *Material* "context", keys will be added to/removed from the active material lpo curves. If it's a 3D view, you'll get the same *Insert Key/Delete Key* menu as if you hit I/AltI in that 3D view...

(VI) *Synchronize with the VSE sound*

Enabling the "speaker" button has basically the same effect as enabling both the *Sync Playback to Frames/Sec* and *Sequencer Windows* options of the *Playback* menu. The playback now includes the sequencer, and uses its audio output as time-reference. Most useful during video editing...

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Markers

Markers are used to denote frames at which something significant happens – it could be that a character’s animation starts, the camera changes position, or a door opens, for example. Markers can be given names to make them more meaningful at a quick glance. They are available in many of Blender’s windows, under different forms. Unlike the keyframes, markers are always placed at a whole frame number, you cannot e.g. set a marker at “frame **2.5**”.

Markers can be created and edited in all of the following editors (including their different modes):

- The [Graph Editor window](#).
- The [Action Editor window](#).
- The [The Dope Sheet](#).
- The [NLA Editor window](#).
- The [Video Sequence Editor window](#).
- The [Timeline window](#). When you create

A marker created in one of these windows will also appear in all others that support them, including:

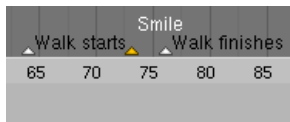
- The [3D View window](#).

Pose markers

There is another type of markers, called “pose markers”, which are specific to the armatures and the *Action Editor* window. They are related to the pose libraries, and are discussed in detail [here](#).

Visualization

Standard



Markers: small but useful.

Most of the window types visualize markers the same way: as small triangles at their bottom, white if unselected or yellow if selected.

If they have a name, this is shown to their right, in white when the marker is selected. See (*Markers: small but useful*).

Sequencer



Markers in the Sequencer

The *Video Sequence Editor* just adds a vertical dashed line to each marker (gray if the marker is unselected, or white if it's selected).

3D View



Marker in a 3D View.

The *3D View* windows do not allow you to create/edit/remove markers, they just show their name between <> at their bottom left corner, near the active object's name, when you are at their frame (see *Marker in a 3D view*).

Creating and Editing Markers

Unfortunately, there is no common shortcuts and menu for marker's editing, across the different window types that supports them... So in the reboxers of each action described below, I put the most-common shortcut and menu entry, with the known exceptions between brackets.

Creating Markers

Mode: all modes

Hotkey: M (CtrlAltM in a VSE)

Menu: Marker » Add Marker (Frame » Add Marker in a timeline)

The simplest way to add a marker is to move to the frame where you would like it to appear, and press M (or CtrlAltM in a video sequence editor).



Alternatively, you can press AltA (or the “playback” button of the *Timeline* window) to make the animation play, and then hit M (or CtrlAltM in VSE) at the appropriate points. This can be especially useful to mark the beats in some music.

Selecting Markers

Mode: all modes

Hotkey: RMB , ⇧ Shift RMB , A/CtrlA, B/CtrlB

Click RMB  on the marker's triangle to select it. Use ⇧ Shift RMB  to (de)select multiple markers.

In the *Ipo Curve Editor*, *Action Editor*, *NLA Editor* and *Video Sequence Editor* windows, you can also (de)select all markers with CtrlA, and border-select them with CtrlB (as usual, LMB  to select, RMB  to deselect). The corresponding options are found in the Select menu of these windows.

In the *Timeline* and *Audio* windows, you can (de)select all markers with A, and border (de)select them with B...

Naming Markers

Mode: all modes

Hotkey: CtrlM

Menu: Marker » (Re)Name Marker (Frame » Name Marker in a timeline)



Having dozens of markers scattered throughout your scene's time won't help you much unless you know what they stand for. You can name a marker by selecting it, pressing CtrlM, typing the name, and pressing the OK button.

Moving Markers

Mode: all modes

Hotkey: CtrlG (G in a timeline or audio)

Menu: Marker » Grab/Move Marker (Frame » Grab/Move Marker in a timeline)

Once you have one or more markers selected, hit CtrlG (or G in *Timeline* or *Audio* windows) to move them, and confirm the move with LMB  or ↵ Enter (as usual, cancel the move with RMB , or Esc).

By default, you grab the markers in one-frame steps, but if you hold Ctrl, the markers will move in steps corresponding to one second – so if you have set your scene to **25 fps**, the markers will move in twenty-five-frames steps.

Duplicating Markers

Mode: all modes

Hotkey: Ctrl⇧ ShiftD (⇧ ShiftD in a timeline or audio)

Menu: Marker » Duplicate Marker (Frame » Duplicate Marker in a timeline)

You can duplicate the selected markers by hitting Ctrl⇧ ShiftD (or ⇧ ShiftD in a *Timeline* or *Audio* window). Once duplicated, the new ones are automatically placed in grab mode, so you can move them where (or rather when) you want.


Note that unlike most other duplications in Blender, the names of the duplicated markers are not altered at all (no “.001” numeric counter append...).

Deleting Markers

Mode: all modes

Hotkey: ⇧ ShiftX (X in a timeline or audio)

Menu: Marker » Delete Marker (Frame » Delete Marker in a timeline)

To delete the selected marker(s) simply press ⇧ ShiftX (or X in a *Timeline* or *Audio* window), and confirm the pop-up message with LMB .

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Void page

Proposed fixes: none

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Keyframes

Keyframes are the basis of animation. Keyframes define the value of data at specified frame.

Quite obviously, something is "animated" when it changes over time. In Blender, animating an object means changing its properties such as its X location, or the Red channel value of its material diffuse color, and so on, during a certain amount of time.

As mentioned, Blender's fundamental unit of time is the "frame", which usually lasts just a fraction of a second, depending on the *frame rate* of the scene.

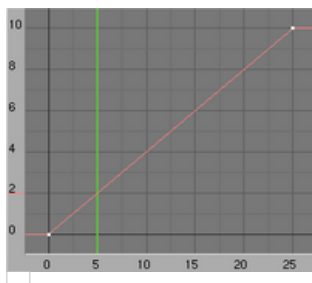
As animation is composed of incremental changes spanning multiple frames, usually these properties ARE NOT manually modified *frame by frame*, because:

- it would take ages!
- it would be very difficult to get smooth variations of the property (unless you compute mathematical functions and type a precise value for each frame, which would be crazy).

This is why nearly all direct animation is done using **interpolation**.

The idea is simple: you define a few "control points", called "**keyframes**", which are multiple frames apart.

Between these keyframes, the properties' values are computed (interpolated) by Blender and filled in. Thus, the animators' workload is significantly reduced. These [Curves](#) can be edited in the [Graph Editor](#)



Example of interpolation

For example, if you have:

- a control point of value **0** at frame **0**,
- another one of value **10** at frame **25**,
- linear interpolation,

then, at frame **5** we get a value of **2**.

The same goes for all intermediate frames: with just two points, you get a smooth growth from **0** to **10** along the **25 frames**. Obviously, if you'd like the frame **15** to have a value of **9**, you'd have to add another control point (or keyframe)...

Creating Keyframes


In the 3D View

Keyframes are set with the hotkey I. A menu appears with the following options:

- Location
- Rotation
- Scale
- LocRot
- LocScale
- LocRotScale
- RotScale
- Visual Location
- Visual Rotation
- Visual Scale
- Delta Location
- Delta Rotation
- Delta Scale

In the Properties Panel

You can add keyframes for almost any modifiable attribute. You can do this by hovering over an attribute and use hotkeys:

- I. The Field will turn yellow, indicating a keyframe has been set.
- Alt+i. Delete the current keyframe.
- Alt+shift+i. Clear all keyframes on this channel.
- RMB  on an attribute, and select Insert Keyframes or Insert Single Keyframe for vector attributes.

In the Animation Editors

You can add keyframes to channels that have existing keyframes in several animation editors, which are described in other pages:

- [Timeline](#)
- [Graph Editor](#)
- [Dope Sheet](#)

Editing Keyframes

There are several ways of editing keyframes, which are covered in other pages, listed above.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

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Animation Editors

Animation is a big task, often involving repetitive work. This is why many different techniques have been developed over the years, to hasten, and reduce the workload facing animators.

To manage all these features, Blender has several Animation editor windows:

The [Timeline](#)

The timeline does not allow editing of animation data, but displays all keyframes of a scene. You can edit [Animation Markers](#) in the timeline.

The [Graph Editor](#)

This is the lowest-level editor, where you use one curve to control each animated property/setting/channel.

The [Dope Sheet](#)

The Dope Sheet (Previously the Action Editor) has Four modes of use. Each are very similar, but work with different types of animation data:

[Dope Sheet](#) Mode

This is a general keyframe editor, which displays all keyed channels of all scene objects.

[Action Editor](#) Mode

This is similar to the Dope Sheet mode, but displays per-object keyframes, and is specific for creating Actions.

[Shape Key Editor](#) Mode

This displays shape key animations for selected objects.

[Grease Pencil](#) Mode

This displays grease pencil animation data that you have done.

The [NLA editor](#)

The idea behind this high-level editor is borrowed from the non-linear video editors: each element represents an action, which you can move, duplicate, shrink/pull (i.e. fasten/slow down), etc., to your liking. If keys are like mesh faces, an 'NLA action' is an object encapsulating those mesh faces, with a modifier.



The important thing to understand is how the progression of animation data is reflected by the animation editors:

- Keyframes form animation Curves,
- ...Which are used to create **Actions**
- ...Which are used by the **NLA**.

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Proposed fixes: Shouldn't this be merged into [Graph - FCurves](#)?

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Images

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Proposed fixes: [X](#)

Working with F-Curves

Once you have created keyframes for something, you can edit their corresponding curves. In Blender 2.5, IPO Curves have been replaced by F-Curves, however, editing these curves is essentially still the same.

The concept of Interpolation

When something is "animated," it changes over time. In Blender, animating an object means changing one of its properties, such as its X location, or the Red channel value of its material diffuse color, and so on, during a certain amount of time.

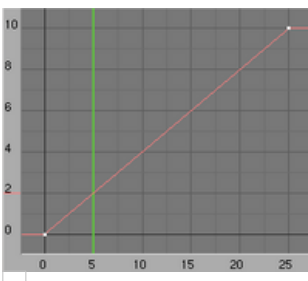
As mentioned, Blender's fundamental unit of time is the "frame", which usually lasts just a fraction of a second, depending on the *frame rate* of the scene.

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- it would take ages!
- it would be very difficult to get smooth variations of the property (unless you compute mathematical functions and type a precise value for each frame, which would be crazy).

This is why nearly all direct animation is done using **interpolation**.

The idea is simple: you define a few Key Frames, which are multiple frames apart. Between these keyframes, the properties' values are computed (interpolated) by Blender and filled in. Thus, the animators' workload is significantly reduced.



Example of interpolation

For example, if you have:

- a control point of value **0** at frame **0**,
- another one of value **10** at frame **25**,
- linear interpolation,

then, at frame **5** we get a value of **2**.

The same goes for all intermediate frames: with just two points, you get a smooth growth from **0** to **10** along the **25 frames**. Obviously, if you'd like the frame **15** to have a value of **9**, you'd have to add another control point (or keyframe)...

Types of Interpolation

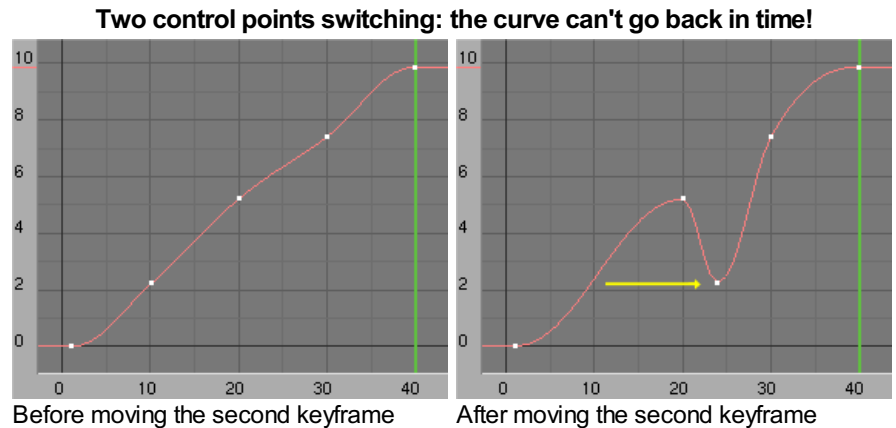
Despite of the name "curve", it might be a set a linear segments, or even a set of discrete values (materialized as a "stairway curve"), depending on the interpolation mode chosen.

Direction of time

Although F-curves are very similar to [Bézier curves](#), there are some important differences.

For obvious reasons, **a property represented by a Curve cannot have more than one value at a given time**, hence:

- when you move a control point ahead of a control point that was previously ahead of the point that you are moving, the two control points switch their order in the edited curve, to avoid that the curve goes back in time
- for the above reason, it's impossible to have a closed lpo curve



Curve Selection

By default, when you add keyframes to a channel, the Graph Editor displays them in Edit Mode. Just like in the 3D View, you can toggle the editability of a channel by pressing \leftrightarrow Tab. In the Channel Box, the lock icon also toggles between edit and "non-edit" mode.

Selection Tools

You can select curve handles clicking LMB (or \diamond Shift LMB for multiple. You can select an entire key by selecting the center point, or just select one the handles

You can also (de)select all visible curves with A (or Select » Select/Deselect All), and do a border-selection with B (or Select » Border Select) – simple LMB click-and-drag to add to the selection, and RMB (or CtrlAlt LMB) to remove from the selection.

Select All A
Invert Selection CtrlI
Border Select B
Border Axis Range AltB
Border (include Handles) CtrlB
Columns on Selected Keys K
Column on current Frame CtrlK
Columns on selected Markers \diamond ShiftK
Between Selected Markers AltK
Before Current Frame [
After Current Frame]
Select More Ctrl+ NumPad
Select Less Ctrl- NumPad
Select Linked L

Editing Curves

Transformations

You can grab (G), rotate (R) and scale (S) the *selected* curves (those visible, with white control points/keyframes) – operations also available from the Curve » Transform sub-menu.

Additionally, for translation and scaling, you can lock the transformation along the X (time) or Y (value) axis, as usual by hitting X or Y during transformation.

You also have the classic "transform snapping" features: holding Ctrl while transforming will snap it to one-frame/one-value steps, while holding \diamond Shift will slow down the movement, increasing its precision. Note however that using \diamond ShiftCtrl just slows down the movement, without reducing the snapping steps.

Copying

You can copy one or more keyframes into a buffer, and then paste them into *the same* curves. This is done through two header

buttons:

- The “copy” CtrlC button (down arrow) copies the *selected and visible* curves into the buffer.
- The “paste” CtrlV button (up arrow) pastes the buffer content into the corresponding *visible* curves of the current channel.

Note that this tool is not working (even though available) in “keyframe” mode. And in edit mode, only the selected points are copied/pasted (not the whole curve...).

You can also **Duplicate** keys through the Key menu.

Deleting

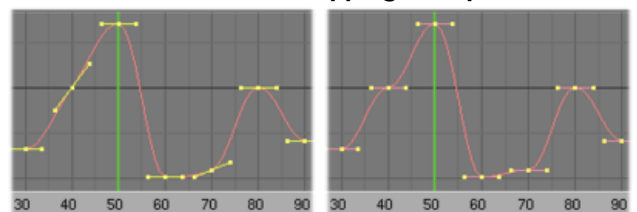
To delete a keyframe, select it (in “default” mode), and hit X (or use Curve » Delete).

Snapping

You have some “snap to” options (⇧ ShiftS or Curve » Snap):

- Horizontal – This is only useful with the default F-curves: it will rotate all control points of the selected curves to set them horizontal.

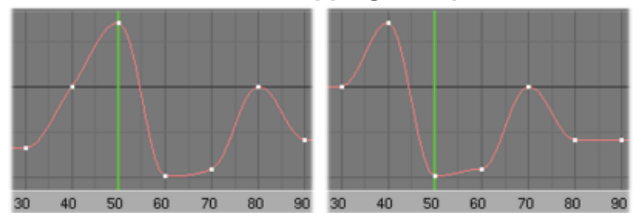
“Horizontal” snapping example.



Before Horizontal snapping. After Horizontal snapping.

- To Next – This will assign to all control points (keyframes) of the selected curves the value of the next one in the same curve (producing a sort of “shifting” of the curve...).

“To Next” snapping example.



Before To Next snapping. After To Next snapping.

- To Frame – This will horizontally (timely) move all keyframes of the selected curves to their nearest frame (e.g. a keyframe defined at frame **23.2** will be moved at frame **23**).
- To Current Frame – This option has no effect in the “default” mode.

Mirror

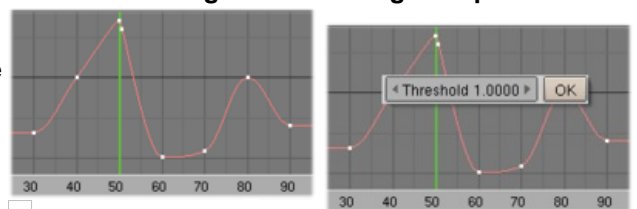
You can mirror the selected curves (⇧ ShiftM or Curve » Mirror), either Over Current Frame (i.e. the green cursor), Over Vertical Axis (i.e. frame **0**), or Over Horizontal Axis (i.e. value **0.0**).

Cleaning and Smoothing

You can clean your selected lpo curves, i.e. remove control points that are very close both in time and value. Hit O (or use the Curve » Clean Keyframes menu entry), set the threshold you like in the dialog that pops-up, and click on OK.

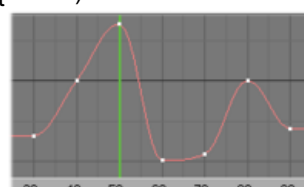
There is also an option to smooth the selected curves (AltO or Curve » Smooth Keys), but beware: its algorithm seems to be to divide by two the distance between each keyframe and the average linear value of the curve, without any setting, which gives quite a strong smoothing! Note that the first and last keys seem to be never modified by this tool.

Cleaning and Smoothing examples.

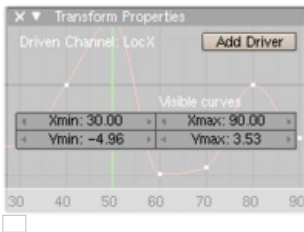


An unclean curve (note the two close points at the cursor).

Cleaning it (note the quite high threshold).



Now that our curve is clean... ...We can smooth it!



The Transform Properties panel of curves in “default” mode.

Transform Properties panel

Yes, as in the 3D views – and also shown/hidden with N (or View » Channel Properties)! In “default” mode, it’s not much useful, as it only shows (and can edit) the X/Y minima/maxima of visible curves as a whole, hence allowing to scale up/down these curves all together.

Sample Keyframes ⇧ ShiftO

Sampling a set a keyframes replaces interpolated values with a new keyframe for each frame.

Bake Curves AltC

Baking a curve replaces it with a set of sampled points, and removes the ability to edit the curve.

Interpolation and Extrapolation

F-curves have three additional properties, which control the interpolation between points, extension behavior, and the type of handles.

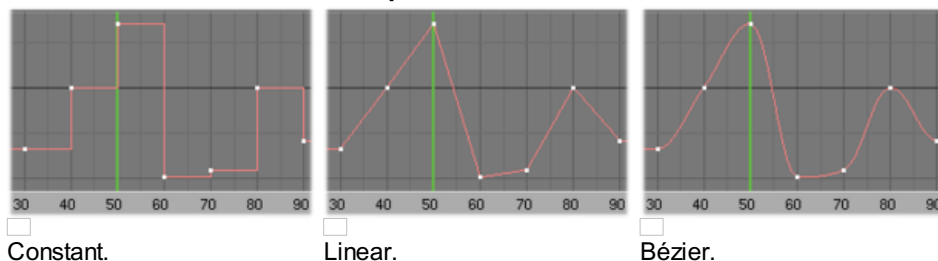
Interpolation

You have three choices (T, or Curve » Interpolation Mode):

- Constant – There is no interpolation at all. The curve constantly have the value of its last keyframe, giving a discrete (stairway) “curve”. Very seldom useful.
- Linear – This simple interpolation creates a straight segment between each neighbor keyframes, giving a broken line. It can be useful when using only two keyframes and the Extrapolation extend mode, to easily get an infinite straight line (i.e. a linear curve).
- Bezier – The more powerful and useful interpolation, and the default one. It gives nicely smoothed curves, i.e. smooth animations!

Remember that some lpo curves can only take discrete values, in which case they are always shown as if constant interpolated, whatever option you chose.

The three interpolations available for curves.



Extrapolation

Extrapolation defines the behavior of a curve before the first and after the last keyframes.

There are two basic extrapolation modes, (⇧ ShiftE, or Channel » Extrapolation Mode):

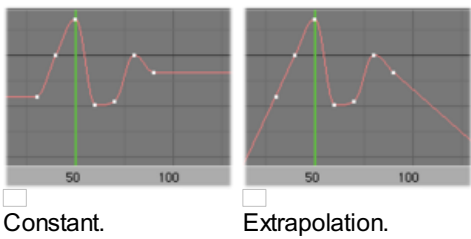
Constant

The default one, curves before their first keyframe and after their last one have a constant value (the one of these first and last keyframes).

Linear

Curves ends are straight lines (linear), as defined by their first two keyframes (respectively their last two keyframes).

The two extensions available for lpo curves.

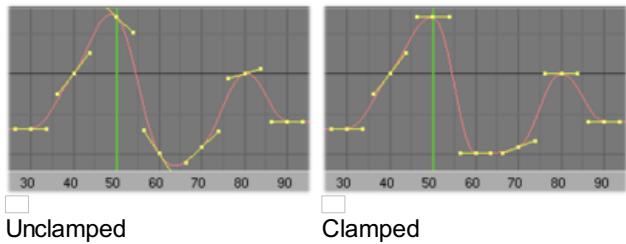


Additional extrapolation tools are located in the [F-Curve Modifiers](#)

Handle Types

There is another curve option quite useful for Bézier-interpolated curves. You can set the type of handle to use for the curve points V

- Automatic**
- Vector**
- Aligned**
- Free**
- Auto Clamped**



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Text partially

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Drivers

Drivers are used to control the animation of one property based on the value of another. This means that their animated value is not controlled by the frame number, but rather by any specified channel. Drivers can take their effects from single properties, differences in rotation, or scripted Python expressions which can be edited inside the UI controls.


For example you could use the X location of a driver to control the colors (RGB curves) of a material, use the rotation of a driver to control the scale of an object, use the scale of a driver to control the shape (through shape keys) of a mesh/curve/etc., use a python function to control a constraint's influence, and much much more...

One key usage of drivers is in character animation: for example, you can add object drivers to the relative shape keys of a face. Then, you manipulate the expressions of your character just by moving these drivers objects (which are set unrenderable, of course!). A bit like using the NLA, but even more friendly! See [Driven Shape Keys](#).

Although their interface and function is similar to that of an F-curve, they sit outside Actions, alongside them in the animation system hierarchy. Drivers are evaluated after Actions, so any F-Curve animation that may be in Actions on the data block will be overridden by the effects of a Driver.

Mapping

A driven curve is not controlled by time (yes, we insist, but it's *very* important to understand this). It's rather its driver's property changes that control where along the X axis of the curve its value is to be taken (i.e. the curve now maps the driver's property value to the curve's property value).

By default, there is a 1 to 1 mapping between the input value, and the output value, defined by a Generator F-Curve Modifier. You can create a custom mapping by deleting this modifier and entering keyframes into the graph area by pressing Ctrl + LMB .

Creating Drivers

To create a driver, find the desired attribute you want to drive, in the properties panel. This will be the attribute that will be **driven** by another attribute.

RMB  on the channel and select one of the following options:

Add Drivers

This will create drivers for channels related to the selected one. For example, it will add drivers to the X, Y, and Z translate.

Add Single Driver

This will just add a single driver to the selected channel.

Editing Drivers

After you have created a driver, you need to specify how that channel will be driven, and by what.

The driver editor is located in the Graph Editor. You can switch from the F-Curve Editor view to the Driver view using the menu on the header.

The Driver editor displays all driver in the current scene. They are listed in the Channel pane on the left side.

If you have multiple drivers in the scene, you can toggle their visibility in the graph area. Also, you need to select the specific channel to begin editing it.

Driver Properties

The driver's properties are located in the Properties Panel on the right side. (This panel is hidden, by default - you can open it by hitting N.)

Update Dependencies

Refreshes the drivers connections.

Driver Types

There are several different driver types that define how the input value of the driver is calculated:

Maximum Value

Takes the highest value of the user variables.

Minimum Value

Takes the lowest value of the user variables.

Sum Values

Takes the sum of user variables

Averaged Values

Averages the values of the user variables

Scripted Expression

Computes a value based on a simple python expression, which can also make use of user variables. (see below)

Variables

User Variables are what produce the input values for a driver. You need at least one variable, unless you are using a scripted expression. When using a single variable, all the driver types listed above, except scripted expression, will produce the same value.

Single Property

Use the Single Property type to call an arbitrary datablock from anything within the scene. This can be anything from the intensity of a lamp, to the color of a texture

Transform Channel

This type allow you to control curves through an object's transform properties – hence, one driver can control separately up to nine curves (the three components of its location, rotation and scale).

To set up an object driver:

- Select the channel you want to drive.
- In the OB field that appears, enter the name of the chosen driver object.
- Unless your driver is an armature, you have only one choice in the Driver type drop-down list, Object.
- Finally, select in the second drop-down list the property you want to drive your curve (Loc X, Scale Z, etc.).

Now, your curve is no more directly controlled by the time, but rather by the value of the property you chose. The values are in Blender Units.

Note that the space in which the driver's properties are evaluated is the local one (i.e. parent's transformations have no effect).

Example

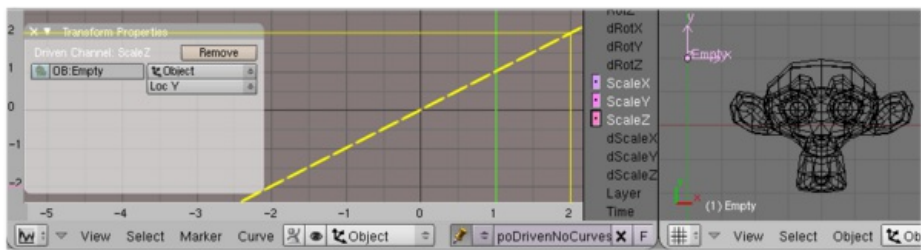
In this example, we are going to control the size of the well-known monkey head (*Suzanne*) with the Y-location of the *Empty* driver. So, we Add Driver to the three ScaleX, ScaleY and ScaleZ channel of the *Suzanne* object (as usual, if there is no curve yet, it is automatically created). Note that for now, **there is no curve**, so Blender applies a one-to-one mapping, as if there was virtual unitary gradient linear curves (materialized as yellow dashed lines in the pictures below). This also illustrates that you can use the same driver property (here, the Y location) for several different drivers...

Object drivers.

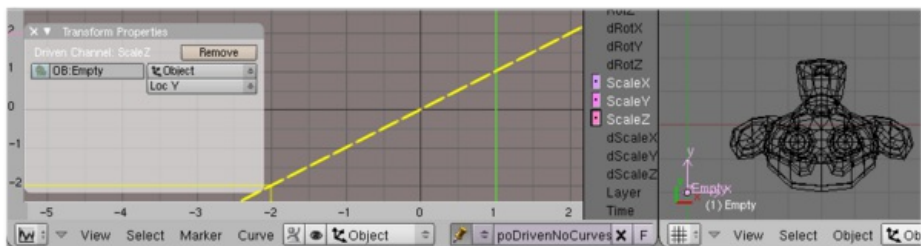
Note that the Curve Editor window is pinned to *Suzanne*'s F-Curve (which allows us to select and grab the *Empty* object while keeping under our eyes the curve it drives!).



The empty driver at Y = 1.0 gives Suzanne a scale of 1.0...



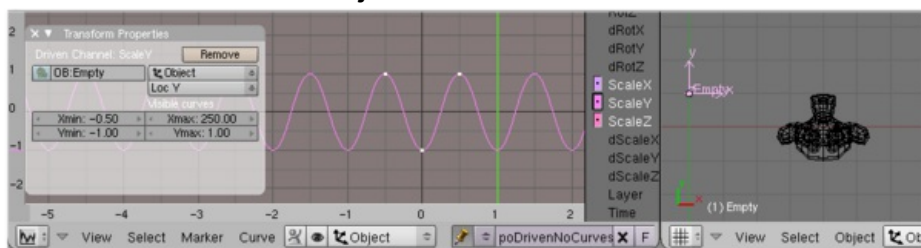
With driver at Y = **2.0**, driven's scale at **2.0**...



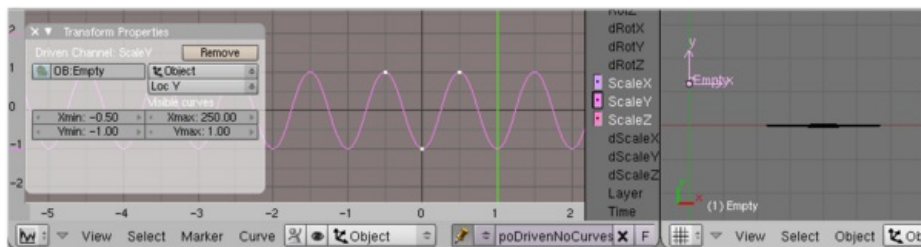
And driver at Y = **-2.0**, driven's scale at... Oh, I think you got it!

Now, we can use curves on drivers to get more complex behavior than the basic one-to-one mapping. Below, we have the same scene as above, but the ScaleY channel now has a pseudo-sinusoidal curve, oscillating between **1.0** and **-1.0** values on a one-frame period, created with three control points and the Cyclic extrapolation (E). This means that, while the X and Z components of Suzanne's scale are still directly controlled by the Y location of Empty, the Y scale component now cyclically varies between **1.0** and **-1.0**, as the following pictures illustrate.

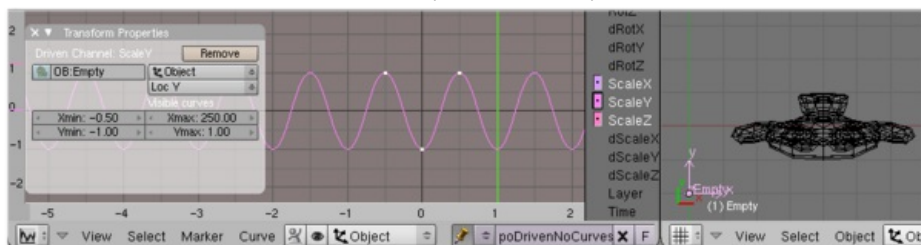
Object driver with curve.



The empty driver at Y = **1.0** gives Suzanne a scale of **(1.0, 1.0, 1.0)**...



With driver at Y = **1.25**, driven's scale at **(1.25, 0.0, 1.25)**...



And driver at Y = **-2.0**, driven's scale at **(-2.0, 1.0, -2.0)**!

Rotational Difference

Rotational difference works only on bones, but are nearly the same as object ones.

You set up a bone driver by entering in the OB field an armature's name, and then selecting the Pose option in the Driver type drop-down list. Then enter the bone's name in the BO field that appears, and select its property to be used.

Note the following specificities:

- The transformations are evaluated in the bone's space (i.e. parent bone's transformations, as well as whole object's ones, have no effects).

- When using the rotation as driver property, you'll find a limitation: the evaluated bone's rotation is always mapped into a $[-180^\circ, 180^\circ]$ range (which means that if you e.g. rotate your bone over the **180°** value, the driven object will "jump back" to its **-180°** X-curve-position...).
- You have an extra driver property: Rotation Difference takes the name of another bone, and uses as driver the angle's value between the two bones.

Distance

Distance mode simply takes the distance between two objects or bones

Expression Drivers

Python expression drivers (or "pydrivers" for short) allow you to use one-line [Python](#) expressions as input for a channel, instead of using a property of another object, like standard drivers do. An expression in programming is any combination of symbols that can be evaluated to a definite value.



You do not directly control the value of the curve with these pydrivers, but rather, as with the other driver types, you control *where along the X axis* the curve value should be taken.

To set up an expression driver, change the driver type to Scripted Expression – it will display a standard text field where you can type your Python expression.

These drivers open up many interesting possibilities: you can use mathematical functions and more general programming to drive object animations. The only restriction is that the pydriver expression *itself* must return a real number when evaluated, and not e.g. a string or something else.

Examples would be using sines or cosines to make objects oscillate around a given point, or using random values at each animation frame to change some material attribute, like diffuse rgb, alpha, etc.

Note that pydriver evaluation is equivalent to what the builtin `eval()` function does, with the restriction that pydriver expressions must return real numbers (any type of number that can be automatically cast to a float).

Valid Expressions

We've already told the basics: there is a text field where you can type an expression in Python. Here are some examples of valid expressions:

- Any real value:

```
1. 1.0
```

- Expressions with numbers and operators:

```
1. 4.5 + 8.9 * 7.0 - (2 / 3.0)
```

- Expressions also with variables:

```
1. math.pi * 2 + 5.0
```

- Available data:

```
1. Blender.Get("curframe") # the current animation frame
```

- A little math:

```
1. math.sin(Blender.Get("curframe")) # the sine of the current frame
```

- Using the animated (driven) object, available as `self`:

```
1. self.LocX * 10
```

Builtin resources and aliases

Pydrivers use their own global dictionary that is cached and only gets recreated when any expression fails. In this dictionary, a few modules are pre-imported, so that they can be used inside pydriver expressions.

Note

To save typing and keep expressions smaller, we've added aliases for each module: Blender can be referenced as "Blender" or simply as "b". Below, each module is followed by its available aliases.

- All from `builtin` (the default `builtin` module)
- `Blender:blender, b`
- `Blender.Noise:noise, n`
- `math:math, m`

Example expression:

```
1. m.cos(m.pi * b.Get("curframe") / n.random())
```

Aliases were also added for a few commonly needed data:

- `ob(name)` is equivalent to `Blender.Object.Get(name)`
- `me(name)` is equivalent to `Blender.Mesh.Get(name)`
- `ma(name)` is equivalent to `Blender.Material.Get(name)`

Example expression:

```
1. ob("Cube").LocX + ob("Lamp").RotZ
```

The pydrivers.py Blender text

Besides the above modules, if there's a Blender text buffer called "`pydrivers.py`" loaded in the Text Editor, it's also imported:

- `pydrivers:pydrivers, p`

This allows users to create their own functions and add their own variables without the restriction of the one-line Python expression. For example, if your `pydrivers.py` text looks like this:

```
1. myvar = 10.0
2.
3. def myfunction(arg):
4.     # do something fancy here
5.     return float_val
```

You can access both `myvar` and `myfunction` inside any expression:

```
1. p.myvar * p.myfunction(2) - 1
```

Note: if you make updates to the `pydrivers.py` text, go to the Curve Editor window and click in any pydriver's text input box (in the Transform Properties panel), then click out of it or press ↵ Enter, to force reloading the `pydrivers.py` module and to update all pydrivers at once.

Example

Let's say we want to give our `Suzanne` a perfect two BU radius circle movement in the (XY) plane. This is not easy to achieve with standard curves, as you have to create perfect sinusoidal ones (for those who lost their math, a perfect circle in a Cartesian plane is obtained with $x = \sin(t)$ and $y = \cos(t)$...). So let's use Python drivers:

The `sin()` and `cos()` math functions take as input a *radian* value (i.e. a cycle takes 2π frames to complete), and output a value in range $[-1.0, 1.0]$. So, to get a **2BU** radius circle fully walked in **50** frames (two seconds in PAL videos), we have to use the following Python expression:

- For LocX:

```
1. 2.0 * math.sin(Blender.Get("curframe")*math.pi/25)
```

- For LocY:

```
1. 2.0 * math.cos(Blender.Get("curframe")*math.pi/25)
```

Now, `Suzanne` will go in endless circles around the world's origin (if you want to make it turn around another point, just add an offset to the above expressions, or drive `dLoc...` curves...).

Note that:

- In the above example, we did not use F-curves.
- You can also get a perfect circular movement by using a [NURBS circle curve](#) as a [path](#)...

Links

- The [Blender 2.49 Python API reference](#) and the chapter on [extending Blender with Python](#).
- [Python](#) and its [documentation](#).
- This might be a good hunting ground for those looking for functions to try with pydrivers: <http://functions.wolfram.com/> (newcomers are recommended to start with elementary ones, specially trigonometric).
- Finally, the patch tracker entry, with patch and sample .blend files for pydrivers: [right here](#).

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Text

Needs clarification & updates.

Proposed fixes: [X](#)

Non-Linear Animation Editor

The NLA editor can manipulate and repurpose actions, without the tedium of keyframe handling. Its often used to make broad, significant changes to a scene's animation, with relative ease. It can also repurpose, and 'layer' actions, which make it easier to organize, and version-control your animation.

Tracks


Tracks are the layering system of the NLA. At its most basic level, it can help organize strips. But it also layers motion much like an image editor layers pixels - the bottom layer first, to the top, last.



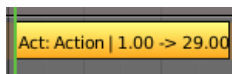
Strips

There's three kinds of strips - Action, Transition, and Meta. Actions contain the actual keyframe data, Transitions will perform calculations between Actions, and Meta will group strips together as a whole.

Creating Action Strips

Any action used by the NLA first must be turned into an Action strip. This is done so by clicking the  next to the action listed in the NLA. Alternatively, you can go to

Menu: Add → Action



Action Strip.

Creating Transition Strips

Select two or more strips on the same track, and go to

Menu: Add → Transition

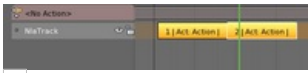


Transition Strip.

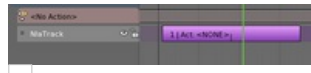
Creating Meta Strips

If you find yourself moving a lot of strips together, it would help to organize them into Meta strips. This groups strips together, so you can move them as one.

Menu: Add → Meta Strips



Shift-select two or more strips..



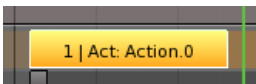
Combine them into a meta strip.

Editing Strips

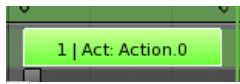
The contents of Action strips can be edited, but you must be in 'Tweak Mode' to do so.

Hotkey: ⇧ Tab

Menu: View → Enter Tweak Mode



Strip in NLA mode..



Strip in Tweak mode.

If you try moving the strip, while in edit mode, you'll notice that the keys will go along with it. On occasion, you'll prefer the keys to remain on their original frames, regardless of where the strip is. To do so, hit the 'unpin' icon, next to the strip.



Nla strip with pinned keys.



Strip moved, notice the keys move with it.



The unpinned keys return to their original frames.

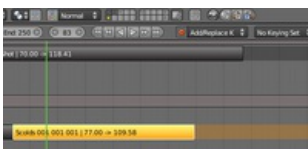
When your finished editing the strip, simply go to View > Exit Tweak Mode. Note the default key for this is Tab.

Re-Instancing Strips

The contents' of one Action strip can be instanced multiple times. To instance another strip, select a strip, go to

Menu: Edit→ Duplicate Strips

Now, when any strip is tweaked, the others will change too. If a strip other than the original is tweaked, the original will turn to red.



Original strip.



Duplicated strip.



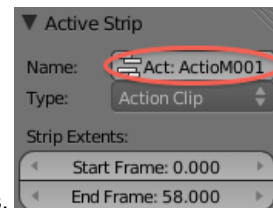
Duplicated strip being edited.

Strip Properties

Strip properties can be accessed via the NLA header.

Menu: View→ Properties

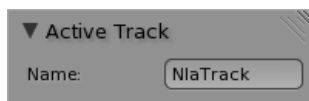
Renaming Strips



All strips can be renamed, in the "Active Track" section in the Strip Properties.

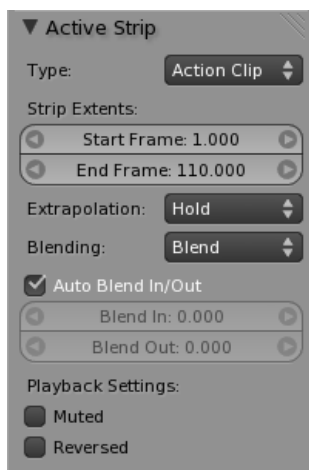
Active Track

This is which track the strip currently belongs to.



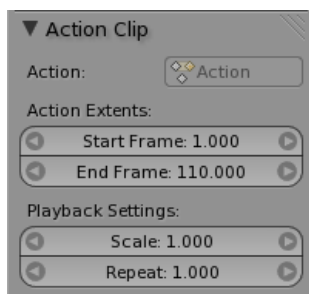
Active Strip

Elements of the strip itself. An Action Strip can be either an Action Clip, or a Transition Clip. Note that the 'Strip Extents' fields determine strictly the strip, and not the action. Also, the "Hold" value in the Extrapolation section means hold both beginning, and after. This can cause previous clips to not work, if checked.

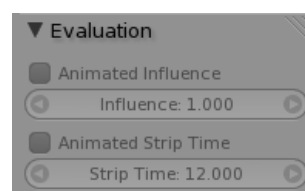


Active Action

This represents the 'object data' of the strip. Much like the transform values of an object.

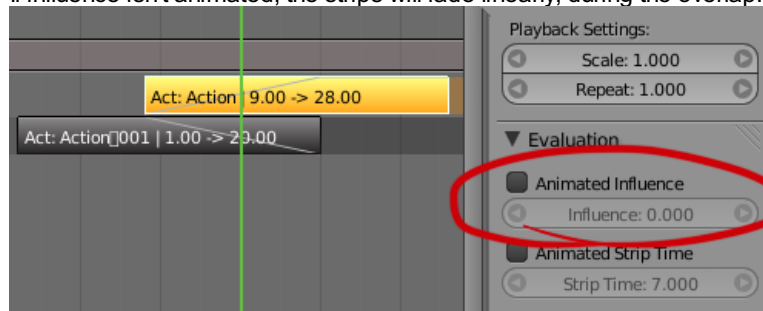


Evaluation



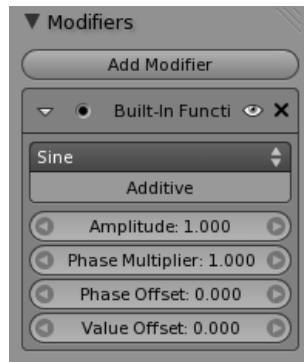
This determines the degree of influence the strip has, and over what time.

If influence isn't animated, the strips will fade linearly, during the overlap.



Strip Modifiers

Like its close cousins in mesh and graph editing, Modifiers can stack different combinations of effects for strips. Obviously there will be more to come on this.



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F-Curve Modifiers

F-Curve modifiers are similar to object modifiers, in that they add non-destructive effects, that can be adjusted at any time, and layered to create more complex effects.

Adding a Modifier

The F-curve modifier panel is located in the Properties panel. Select a curve by selecting one of its curve points, or by selecting the channel list. Click on the **Add Modifier** button and select a modifier.

Types of Modifiers

Generator

Generator creates a Factorized or Expanded Polynomial function. These are basic mathematical formulas that represent lines, parabolas, and other more complex curves, depending on the values used.

Additive

This option causes the modifier to be added to the curve, instead of replacing it by default.

Poly Order

Specify the order of the polynomial, or the highest power of 'x' for this polynomial. (number of coefficients - 1).

Change the Coefficient values to change the shape of the curve. See [\[The Wikipedia Page\]](#) for more information on polynomials.

Built-in Function

These are additional formulas, each with the same options to control their shape. Consult mathematics reference for more detailed information on each function.

- Sine
- Cosine
- Tangent
- Square Root
- Natural Logarithm
- Normalized Sine ($\sin(x)/x$)

Amplitude

Adjusts the Y scaling

Phase Multiplier

Adjusts the X scaling

Phase Offset

Adjusts the X offset

Value Offset

Adjusts the Y offset

Envelope

Allows you to adjust the overall shape of a curve with control points.

Reference Value

Set the Y value the envelope is centered around.

Min

Lower distance from Reference Value for 1:1 default influence.

Max

Upper distance from Reference Value for 1:1 default influence.

Add Point

Add a set of control points. They will be created at the current frame.

Fra:

Set the frame number for the control point.

Min

Specifies the lower control point's position.

Max

specifies the upper control point's position.

Cycles

Cycles allows you add cyclic motion to a curve that has 2 or more control points. The options can be set for before and after the curve.

Cycle Mode

Repeat Motion

Repeats the curve data, while maintaining their values each cycle.

Repeat with Offset

Repeats the curve data, but offsets the value of the first point to the value of the last point each cycle.

Repeat Mirrored

Each cycle the curve data is flipped across the X-axis.

Before/After Cycles

Set the number of times to cycle the data. A value of 0 cycles the data infinitely.

Noise

Modifies the curve with a noise formula. This is useful for creating subtle or extreme randomness to animated movements, like camera shake.

Blend Type

Replace

Adds a -.5 to .5 range noise function to the curve.

Add

Adds a 0 to 1 range noise function to the curve.

Subtract

Subtracts a 0 to 1 range noise function to the curve.

Multiply

Multiplies a 0 to 1 range noise function to the curve.

Scale

Adjust the overall size of the noise. Values further from 0 give less frequent noise.

Strength

Adjusts the Y scaling of the noise function.

Phase

Adjusts the random seed of the noise.

Depth

Adjusts how detailed the noise function is.

Python

Limits

Limit curve values to specified X and Y ranges.

Minimum/Maximum X

Cuts a curve off at these frames ranges, and sets their minimum value at those points.

Minimum/Maximum Y

Truncates the curve values to a range.

Stepped

Gives the curve a stepped appearance by rounding values down within a certain range of frames.

Step Size

Specify the number of frames to hold each frame

Offset

Reference number of frames before frames get held. Use to get hold for '1-3' vs '5-7' holding patterns.

Use Start Frame

Restrict modifier to only act before its 'end' frame

Use End Frame

Restrict modifier to only act after its 'start' frame

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Using Constraints in Animation

[Constraints](#) are a way to control an object's properties (its location/rotation/scale), using either plain static values (like the ["limit" ones](#)), or (an)other object(s), called "targets" (like e.g. the ["copy" ones](#)).

Even though these constraints might be useful in static projects, their main usage is obviously in animation. There are two different aspects in constraints' animation:

- You can control an object's animation through the targets used by its constraints (this is a form of indirect animation).
- You can animate constraints' settings

Controlling Animation with Constraints

This applies only to constraints using target(s). Indeed, these targets can then control the constraint's owner's properties, and hence, animating the targets will indirectly animate the owner.

This indirect "constraint" animation can be very simple, like for example with the [Copy Location constraint](#), where the owner object will simply copy the location of its target (with an optional constant offset). But you can also have very complex behaviors, like when using the [Action constraint](#), which is a sort of [Animation Driver](#) for actions!

We should also mention the classical [Child Of constraint](#), which creates parent/child relationship. These relationships indeed imply indirect animation (as transforming the parent affects by default all its children). But the Child Of constraint is also very important, as it allows you to parent your objects to bones, and hence use [Armatures](#) to animate them!

Back to our simple Copy Location example, you can have two different behaviors of this constraint:

- When its Offset button is disabled (the default), the location of the owner is "absolutely" controlled by the constraint's target, which means nothing (except other constraints below in the stack...) will be able to control the owner's position. Not even the object's animation curves.
- However, when the Offset button is enabled, the location of the owner is "relatively" controlled by the constraint's target. This means that location's properties of the owner are offset from the location of the target. And these owner's location properties can be controlled e.g. by its Loc... curves (or actions, or NLA...)!

Example

Let's use the Copy Location constraint and its Offset button. For example, you can make your owner (let's call it `moon`) describe perfect circles centered on the `(0.0, 0.0, 0.0)` point (using e.g. pydriven LocX/LocY animation curves, see [this page](#)), and then make it copy the location of a target (called, I don't know... `earth`, for example) – with the Offset button enabled. Congratulations, you just modeled a satellite in a (simplified) orbit around its planet... Just do the same thing with its planet around its star (which you might call `sun`, what do you think?), and why not, for the star around its galaxy...

Here is a small animation of a "solar" system created using (among a few others) the technique described above:

Note that the this "solar" system is not realistic at all (wrong scale, the "earth" is rotating in the wrong direction around the "sun", ...).

You can download the the .blend file ([File:ManAnimationTechsUsingConstraintsExSolarSys.blend](#)) used to create this animation.

Animating Constraints Influence

More “classically”, you can also animate a few properties of each constraint using animation curves.

You only have two animation curves (see also [this page](#)):

- You can animate the Influence of a constraint. For example, in the [“solar system” example above](#), I used it to first stick the camera to the “moon”, then to the “earth”, and finally to nothing, using two Copy Location constraints with Offset set, and their Influence cross-fading together...
- More anecdotal, you can also, for some constraints using an armature’s bone as target, animate where along this bone (between root and tip) lays the real target point (**0.0** means “full-root”, and **1.0**, “full-tip”).

Moving Objects on a Path

To make objects move along a path is a very common animation need. Think of a complex camera traveling, a train on his rails – and most other vehicles can also use “invisible” tracks! –, the links of a bicycle chain, etc. All these movements could obviously be done with standard lpo curves, but this would be a nightmare! It's much more easy and intuitive to define a path materializing the desired movement, and make your object(s) follow it.

Blender features you two different constraints to make an object follow a path, which have different ways to determine/animate the position of their owner along their path.

In Blender, any [curve object](#) can become a path. A curve becomes a path when its Path Animation button is enabled in the Curve data panel, but you don't even have to bother about this: once a curve is selected as target for a “path” constraint, it automatically is enabled.

You can also directly add a “path” from the Add » Curve » Path menu entry (in a 3D view). This will insert in your scene a *three-dimensional* NURBS curve. This is an important point: by default, Blender's curve are 2 dimensional, i.e. are laid on a plane, which is often not the desired behavior of a path. To turn a standard curve three-dimensional, enable its 3D button, in the same Curve and Surface editing panel.

One last curve property that is important for a path is its *direction*, which is, for three-dimensional ones, materialized by its small arrows. You can switch it with the Curve » Segments » Switch Direction menu entry (or W2 NumPad).

For more on editing path/curves, see the [modeling chapter](#).

{{Note|Shapes on Curves|If you would rather like to have your object's *shape* follow a path (like e.g. a sheet of paper inside a printer), you should use the [Curve Modifier](#)

Parenting Method

Older versions of Blender did not have constraints to make an object follow a path. They used a different method (deprecated, but still available), based on parenting.

To use this method, select the object that will follow the path, then ⇧ Shift select the curve, and use CtrlP to bring up the parenting menu. Choose Follow Path. The object will now be animated along the path.

The settings for the path animation are in the Path Animation panel of the Curve properties panel.

Frames

Defines the number of frames it takes for the object to travel the path.

Evaluation Time

Defines current frame of the animation. By default it is linked to the global frame number, but could be keyframed to give more control over the path animation.

Follow

Causes the curve path children to rotate along the curvature of the path.

Radius

Causes the curve path child to be scaled by the set curve radius. See [Curve Extruding](#)

Offset Children

Causes the animation to be offset by the curve path child's time offset value, which can be found in its Animation Hacks section of the Object Panel.

The Follow Path Constraint

The Follow Path constraint implements the most “classical” technique. By default, the owner object will walk the whole path only once, starting at frame one, and over **100** frames. You can set a different starting frame in the Offset field of the constraint panel, and change the length (in frames) of the path using its Frames property (Curve and Surface panel).

But you can have a much more precise control over your object's movement along its path by keyframing or defining a Speed animation curve for the path's Evaluation Time attribute. This curve maps the current frame to a position along the path, from **0.0** (start point) to **1.0** (end point).

For more details and examples, see the [Follow Path constraint page](#).

The Clamp To Constraint

Another method of keeping objects on a path is to use the Clamp To constraint, which implements a more advanced technique. To determine where along the path should lay its owner, it uses the *location of this owner* along a given axis. So to animate the movement of your owner along its target path, you have to animate some way (lpo curves or other indirect animation) its location.

This implies that here, the length of the path have no more any effect – and that by default, the object is static somewhere on the path!

For more details and examples, see the [Clamp To constraint page](#).

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Introduction to Physics Simulation

This chapter covers various advanced Blender effects, often used to simulate real physical phenomena, such as:

- Smoke
- Rain
- Dust
- Cloth
- Water
- Jello

[Particle Systems](#) can be used to simulate many things: hair, grass, smoke, flocks.

[Hair](#) is a subset of the particle system, and can be used for strand-like objects, such as hair, fur, grass, quills, etc.

[Soft Bodies](#) are useful for everything that tends to bend, deform, in reaction to forces like gravity or wind, or when colliding with other objects... It can be used for skin, rubber, and even clothes, even though there is separate [Cloth Simulation](#) specific for cloth-like objects.

[Rigid Bodies](#) can simulate dynamic objects that are fairly rigid.

[Fluids](#), which include liquids and gasses, can be simulated, including [Smoke](#).

[Force Fields](#) can modify the behavior of simulations.

Gravity

Gravity is a global setting that is applied the same to all physics systems in a scene, which can be found in the scene tab. This value is generally fine left at its default value, at -9.810 in the Z axis, which is the force of gravity in the real world. Lowering this value would simulate a lower or higher force of gravity.

Note that you can scale down the gravity value per physics system in the Field Weights tab.

Partial page Text Boid isn't explained, need more img

Proposed fixes: none

Force Fields

Force Fields offer a way to add extra movement to dynamic systems. [Particles](#), [Soft Bodies](#) and [Cloth objects](#) can all be affected by forces fields. Force Fields automatically affect everything. To remove a simulation or particle system from their influence, simply turn down the influence of that type of Force Field in its Field Weights panel.

- All types of objects and particles can generate fields, but only curve object can bear Curve Guides fields.
- Force Fields can also be generated from particles. See [Particle Physics](#)
- The objects need to share at least one common layer to have effect.

You may limit the effect on particles to a group of objects (see the [Particle Physics](#) page).

Creating a Force Field

Mode: Object Mode

Panel: Object context → Physics sub-context → Fields

Hotkey: F7

To create a single Force Field, you can select Add » Force Field and select the desired force field. This method creates an Empty with the force field attached.

To create a field from an existing object you have to select the object and change to the Physics sub-context. Select the field type in the Fields menu.

The fields have many options in common, these common options are explained for the Spherical field.

Note

After changing the fields (Fields panel) or deflection (Collision panel) settings, you have to recalculate the particle, softbody or cloth system (Free Cache), this is not done automatically. You can clear the cache for all selected objects with CtrlB → Free cache selected.

Particles react to all kind of Force Fields, Soft Bodies only to Spherical/Wind/Vortex (they react on Harmonic fields but not in a useful way).

Common Field Settings

Most Fields have the same settings, even though they act very differently. Settings unique to a field type are described below. Curve Guide and Texture Fields have very different options.

Shape

The field is either a Point, with omnidirectional influence, or a Plane, constant in the XY-plane, changes only in Z direction.

Strength

The strength of the field effect. This can be positive or negative to change the direction that the force operates in. A force field's strength is scaled with the force object's scale, allowing you to scale up and down scene, keeping the same effects.

Flow

Convert effector force into air flow velocity.

Noise

Adds noise to the strength of the force.

Seed

Changes the seed of the random noise.

Effect Point

You can toggle the field's effect on particle Location and Rotation

Collision Absorption

Force gets absorbed by collision objects.

Falloff

Here you can specify the shape of the force field (if the Fall-off Power is greater than 0).

Sphere

Falloff is uniform in all directions, as in a sphere.

Tube

Fall off results in a tube shaped force field.

The Field's Radial falloff can be adjusted, as well as the Minimum and Maximum distances of the field.

Cone

Fall off results in a cone shaped force field. Additional options are the same as those of Tube options.

Z Direction

Fall-off can be set to apply only in the direction of the positive Z Axis, negative Z Axis, or both.

Power (Power)

How the power of the force field changes with the distance from the force field. If r is the distance from the center of the object, the force changes with $1/r^{\text{Power}}$. A Fall-off of 2 changes the force field with $1/r^2$, which is the falloff of gravitational pull.

Max Distance

Makes the force field only take effect within a specified maximum radius (shown by an additional circle around the object).

Min Distance

The distance from the object center, up to where the force field is effective with full strength. If you have a Fall-off of 0 this parameter does nothing, because the field is effective with full strength up to Max Dist (or the infinity). Shown by an additional circle around the object.

Field Types

Force

The Force field is the simplest of the fields. It gives a constant force towards (positive strength) or away from (negative strength) the object's center. Newtonian particles are attracted to a field with negative strength, and are blown away from a field with positive strength.

For [Boids](#) a field with positive strength can be used as a *Goal*, a field with negative strength can be used as *Predator*. Whether Boids seek or fly goals/predators depends on the Physics settings of the Boids.



Image 2b:
Spherical field
indicator.

Wind

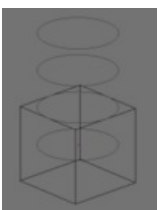


Image 3a:
Wind field
indicator.

Wind gives a constant force in a single direction, along the force object's local Z axis. The strength of the force is visualized by the spacing of the circles shown.

Vortex Field

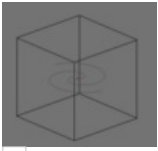


Image 3b:
Vortex field
indicator.

Vortex fields give a spiraling force that twists the direction of points around the force object's local Z axis. This can be useful for making a swirling sink, or tornado, or kinks in particle hair.

Magnetic

This field depends on the speed of the particles. It simulates the force of magnetism on magnetized objects.

Harmonic

The source of the force field is the zero point of a harmonic oscillator (spring, pendulum). If you set the Damping parameter to 1, the movement is stopped in the moment the object is reached. This force field is really special if you assign it to particles.

Rest Length

Controls the rest length of the harmonic force.

Multiple Springs

Causes every point to be affected by multiple springs.

Normally every particle of the field system influences every particle of the target system. Not with Harmonic! Here every target particle is assigned to a field particle. So particles will move to the place of other particles, thus forming shapes. [Tutorial: Particles forming Shapes](#).

Charge

It is similar to spherical field except it changes behavior (attract/repulse) based on the effected particles charge field (negative/positive), like real particles with a charge. This mean this field has only effect on particles that have also a Charge field (else, they have no "charge", and hence are unaffected)!

Lennard-Jones

This field is a very short range force with a behavior determined by the sizes of the effector and effected particle. At a distance smaller than the combined sizes the field is very repulsive and after that distance it's attractive. It tries to keep the particles at an equilibrium distance from each other. Particles need to be at a close proximity to each other to be effected by this field at all.

Particles can have for example both a charge and a Lennard-Jones potential - which is probably something for the nuclear physicists amongst us.

Texture field

You can use a texture force field to create an arbitrarily complicated force field, which force in the 3 directions is color coded. Red is coding for the x-axis, green for the y-axis and blue for the z-axis (like the color of the coordinate axes in the 3D window). A value of 0.5 means no force, a value larger than 0.5 acceleration in negative axis direction (like -Z), a value smaller than 0.5 acceleration in positive axis direction (like +Z).

Texture mode

This sets the way a force vector is derived from the texture.

RGB

Uses the color components directly as the force vector components in the color encoded directions. You need an RGB texture for this, e.g. an image or a colorband. So a Blend texture without a colorband would not suffice.

Gradient

Calculates the force vector as the 3d-gradient of the intensity (grayscale) of the texture. The gradient vector always points to the direction of increasing brightness.

Curl

Calculates the force vector from the curl of the 3d-rgb texture (rotation of rgb vectors). This also works only with a color texture. It can be used for example to create a nice looking turbulence force with a color clouds texture with perlin noise.

Nabla

It is the offset used to calculate the partial derivatives needed for Gradient and Curl texture modes.

Use Object Coordinates

Uses the emitter object coordinates (and rotation & scale) as the texture space the particles use. Allows for moving force fields, that have their coordinates bound to the location coordinates of an object.

Root Texture Coordinates

This is useful for hair as it uses the texture force calculated for the particle root position for all parts of the hair strand.

2D

The 2D button disregards the particles z-coordinate and only uses particles x&y as the texture coordinates.

Remember that only procedural texture are truly 3D.

Examples

- A single colored texture 0.5/0.0/0.5 creates a force in the direction of the positive y-axis, e.g. hair is orientated to the y-axis.
- A blend texture with colorband can be used to created a force "plane". E.g. on the left side 0.5/0.5/0.5, on the right side 1.0/0.5/0.5 you have a force plane perpendicular to XY (i.e. parallel to Z). If you use an object for the coordinates, you can use the object to push particles around.
- An animated wood texture can be used to create a wave like motion.

Curve Guide

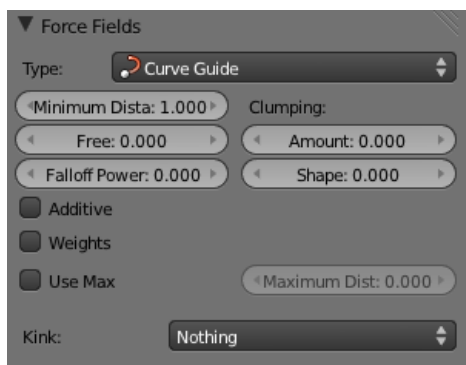


Image 4a: A Curve Guide field.

Curve objects can be the source of a Curve Guide field. You can guide particles along a certain path, they don't affect Softbodies. A typical scenario would be to move a red blood cell inside a vein, or to animate the particle flow in a motor. You can use Curve Guides also to shape certain hair strands - though this may no longer be used as often now because we have the [Particle Mode](#). Since you can animate curves as Softbody or any other usual way, you may build very complex animations while keeping great control and keeping the simulation time to a minimum.

The option Curve Follow does not work for particles. Instead you have to set Angular Velocity (in the Physics panel of the Particle sub-context) to Spin and leave the rotation constant (i.e. don't turn on Dynamic).

Curve Guides affect all particles on the same layer, independently from their distance to the curve. If you have several guides in a layer, their fields add up to each other (the way you may have learned it in your physics course). But you can limit their influence radius:

Minimum Distance

The distance from the curve, up to where the force field is effective with full strength. If you have a Fall-off of 0 this parameter does nothing, because the field is effective with full strength up to MaxDist (or the infinity). MinDist is shown with a circle at the endpoints of the curve in the 3D window.

Free

Fraction of particle life time, that is not used for the curve.

Fall-off

This setting governs the strength of the guide between MinDist and MaxDist. A Fall-off of 1 means a linear progression.

A particle follows a Curve Guide during it's lifetime, the velocity depends from it's lifetime and the length of the path.

Additive

If you use Additive, the speed of the particles is also evaluated depending on the Fall-off.

Weights

Use Curve weights to influence the particle influence along the curve.

Maximum Distance/Use Max

The maximum influence radius. Shown by an additional circle around the curve object.

The other settings govern the form of the force field along the curve.

Clumping Amount

The particles come together at the end of the curve (1) or they drift apart (-1).

Shape

Defines the form in which the particles come together. +0.99: the particles meet at the end of the curve. 0: linear progression along the curve. -0.99: the particles meet at the beginning of the curve.

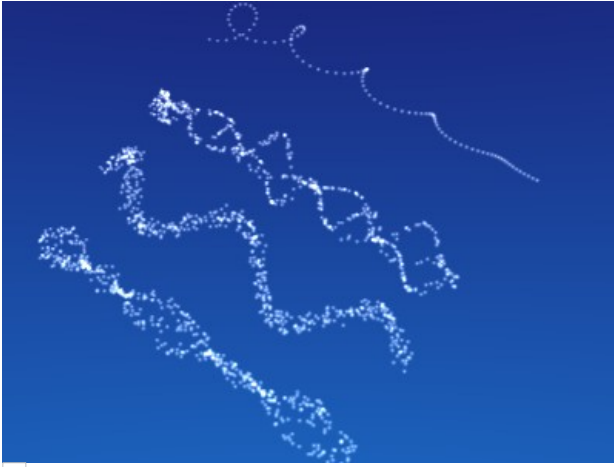


Image 4b: Kink options of a curve guide. From left to right: Radial, Wave, Braid, Roll.

[Animation](#)

With the drop down box Kink, you can vary the form of the force field:

Curl

The radius of the influence depends on the distance of the curve to the emitter.

Radial

A three dimensional, standing wave.

Wave

A two dimensional, standing wave.

Braid

Braid.

Roll

A one dimensional, standing wave.

It is not so easy to describe the resulting shapes, I hope it's shown clearly enough in (*Image 4b*).

Frequency

The frequency of the offset.

Shape

Adjust the offset to the beginning/end.

Amplitude

The Amplitude of the offset.

Boid

...

Turbulence

Create a random turbulence effect with a 3d noise.

Size

Indicates the scale of the noise.

Global

Makes the size and strength of the noise relative to the world, instead of the object it is attached to.

Drag

Drag is a force that works to resist particle motion by slowing it down.

Linear

Drag component proportional to velocity.

Quadratic

Drag component proportional to the square of the velocity.

Links

- [Wind & Deflector force update 2.48](#)
- [Particle options and guides \(v2.40\)](#)

Collisions

[Particles](#), [Soft Bodies](#) and [Cloth objects](#) may collide with mesh objects. [Boids](#) try to avoid Collision objects.

- The objects need to share at least one common layer to have effect.
- You may limit the effect on particles to a group of objects (in the [Field Weights panel](#)).
- *Deflection* for softbody objects is difficult, they often penetrate the colliding objects.
- Hair particles ignore deflecting objects (but you can animate them as softbodies which take deflection into account).

If you change the deflection settings for an object you have to recalculate the particle, softbody or cloth system (Free Cache), this is not done automatically. You can clear the cache for all selected objects with CtrlB → Free cache selected.

Mode: Object Mode

Panel: Object context → Physics sub-context → Collision

Options

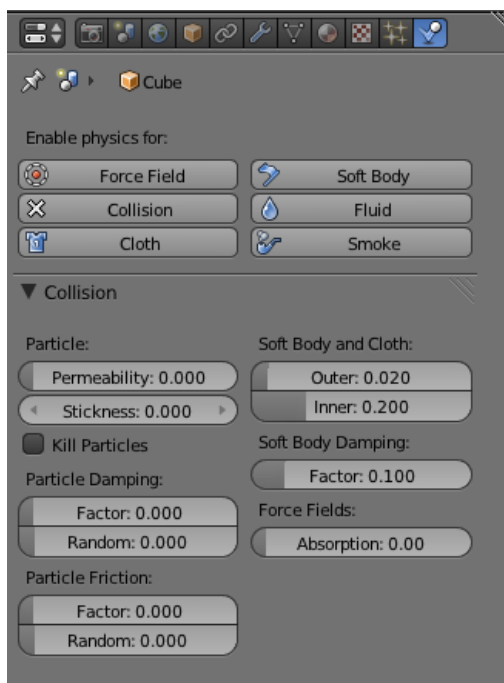


Image 1: Collision panel in the Physics sub-context.

Permeability

Fraction of particles passing through the mesh. Can be animated with Object lpos, Perm channel.

Stickiness

How much particles stick to the object.

Kill Particles

Deletes Particles upon impact.

Damping Factor

Damping during a collision (independent of the velocity of the particles).

Random damping

Random variation of damping.

Friction Factor

Friction during movements along the surface.

Random friction

Random variation of friction.

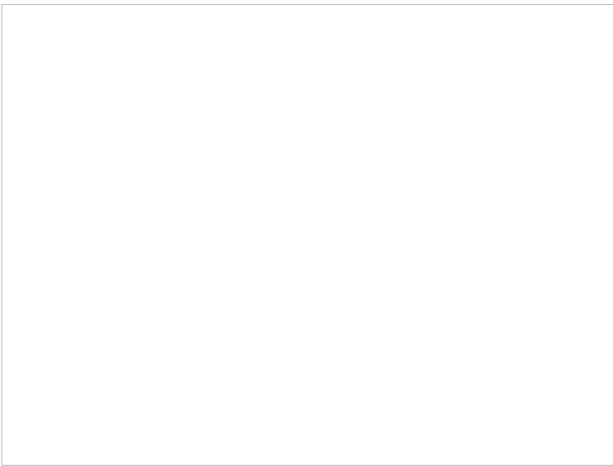


Image 1b: A softbody vertex colliding with a plane.

Soft Body and Cloth Interaction

Outer

Size of the outer collision zone.

Inner

Size of the inner collision zone (padding distance).

Outside and inside is defined by the face normal, depicted as blue arrow in (*Image 1b*).

Damping Factor

Damping during a collision.

Softbody collisions are difficult to get perfect. If one of the objects move too fast, the soft body will penetrate the mesh. See also the section about [Soft Bodies](#).

Force Field Interaction

Absorption

A deflector can also deflect effectors. You can specify some collision/deflector objects which deflect a specific portion of the effector force using the Absorption value. 100% absorption results in no force getting through the collision/deflector object at all. If you have 3 collision object behind each other with e.g. 10%, 43% and 3%, the absorption ends up at around 50% ($100 \times (1 - 0.1) \times (1 - 0.43) \times (1 - 0.03)$).

Examples



Image 2: Deflected Particles.

Here is a Meta object, duplivered to a particle system emitting downwards, and deflected by a mesh cube:

Hints

- Make sure that the normals of the mesh surface are facing towards the particles/points for correct deflection.
- Hair particles react directly to force fields, so if you use a force field with a short range you don't need necessarily collision.
- Hair particles avoid their emitting mesh if you edit them in Particle mode. So you can at least model the hair with collision.

Particles

Particles are lots of items emitted from mesh objects, typically in the thousands. Each particle can be a point of light or a mesh, and be joined or dynamic. They may react to many different influences and forces, and have the notion of a lifespan. Dynamic particles can represent fire, smoke, mist, and other things such as dust or magic spells.

[Hair](#) type particles are a subset of regular particles. Hair systems form strands that can represent hair, fur, grass and bristles.

You see particles as a Particle modifier, but all settings are done in the Particle sub-context of the Object context.

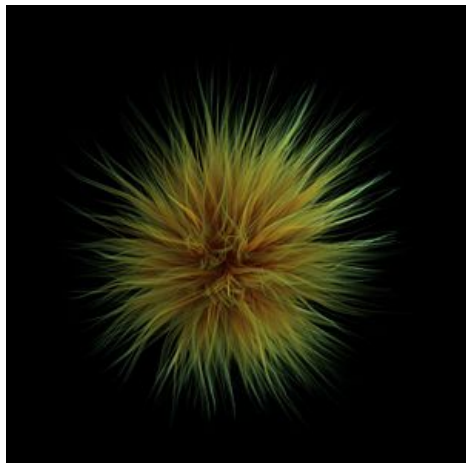


Image 1: Some fur made from particles
([Blend file](#)).

Particles generally flow out from their mesh into space. Their movement can be affected by many things, including:

- Initial velocity out from the mesh.
- Movement of the emitter (vertex, face or object) itself.
- Movement according to “gravity” or “air resistance”.
- Influence of force fields like wind, vortexes or guided along a curve.
- Interaction with other objects like collisions.
- Partially intelligent members of a flock (herd, school, ...), that react to other members of their flock, while trying to reach a target or avoid predators.
- Smooth motion with softbody physics (only Hair particle systems).
- Or even manual transformation with [Lattices](#).

Particles may be rendered as:

- [Halos](#) (for Flames, Smoke, Clouds).
- Meshes which in turn may be animated (e.g. fish, bees, ...). In these cases, each particle “carries” another object.
- [Strands](#) (for [Hair](#), [Fur](#), [Grass](#)); the complete way of a particle will be shown as a strand. These strands can be manipulated in the 3D window (combing, adding, cutting, moving, etc).

Every object may carry many particle systems. Each particle system may contain up to 100.000 particles. Certain particle types (Hair and Keyed) may have up to 10.000 children for each particle (children move and emit more or less like their respective parents). The size of your memory and your patience are your practical boundaries.

Incompatibility with Prior Versions

There are many differences between the “old” particle system that was used up to and including version 2.45, and the “new” particle system. There are many things possible now that could not be done with the old system. The new system is incompatible to the old system, though Blender tries to convert old particle systems, which works only to some extent. The old system is most like the new Emitter system (keep reading to find out what that is). If you are using an old version of Blender 2.45 and previous, [click here to access the old documentation](#).

Workflow

The process for working with standard particles is:

1. Create the mesh which will emit the particles.
2. Create one or more Particle Systems to emit from the mesh. Many times, multiple particle systems interact or merge with each other to achieve the overall desired effect.
3. Tailor each Particle System’s settings to achieve the desired effect.

4. Animate the base mesh and other particle meshes involved in the scene.
5. Define and shape the path and flow of the particles.
6. For [Hair](#) particle systems: Sculpt the emitter's flow (cut the hair to length and comb it for example).
7. Make final render and do physics simulation(s), and tweak as needed.

Creating a Particle System

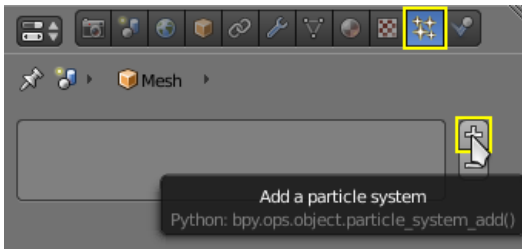


Image 2: Adding a particle system.

To add a new particle system to an object, go to the Particles tab of the object Settings editor and click the small + button. An object can have many Particle Systems.

Each particle system has separate settings attached to it. These settings can be shared among different particle systems, so one doesn't have to copy every setting manually and can use the same effect on multiple objects. Using the Random property they can be randomized to look slightly different, even when using the same settings.

Types of Particle systems

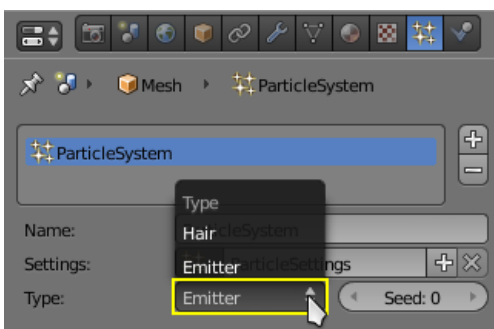


Image 3: Particle system types.

After you have created a particle system, the Property window fills with many panels and buttons. But don't panic! There are two different types of particle systems, and you can change between these two with the Type drop-down list:

Emitter

This parallels the old system to the greatest extent. In such a system, particles are emitted from the selected object from the Start frame to the End frame and have a certain lifespan.

[Hair](#)

This system type is rendered as strands and has some very special properties: it may be edited in the 3D window in realtime and you can also animate the strands with [Cloth Simulation](#).

The settings in the Particle System panel are partially different for each system type. For example, in *Image 3* they are shown for only system type Emitter.

Common Options

Each system has the same basic sets of controls, but options within those sets vary based on the system employed. These sets of controls are:

Emission	Settings for the initial distribution of particles on the emitter and the way they are born into the scene.
Cache	In order to increase realtime response and avoid unnecessary recalculation of particles, the particle data can be cached in memory or stored on disk.
Velocity	Initial speed of particles.
Rotation	Rotational behavior of particles.
Physics	How the movement of the particles behaves.
Render	Rendering options.
Display	Realtime display in the 3D View.

Children	Control the creation of additional child particles.
Field Weights	Factors for external forces.
Force Field Settings	Makes particles force fields.
Vertex Groups	Influencing various settings with vertex groups.

Links

- [Tutorials](#)
- [Physics Caching and Baking](#)
- [Particle Rewrite Documentation](#)
- [Thoughts about the particle rewrite code](#)
- [Static Particle Fur Library](#)

Particle Emission

The Emitter system works just like its name says: it emits/produces particles for a certain amount of time. In such a system, particles are emitted from the selected object from the Start frame to the End frame and have a certain lifespan. These particles are rendered default as [Halos](#), but you may also render these kind of particles as objects (depending on the particle system's render settings, see [Visualization](#)).

Options

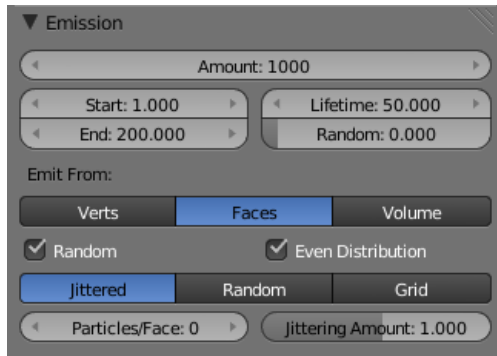


Image 2a: Settings for particle Emission.

The buttons in the Emission panel control the way particles are emitted over time:

Amount

The maximum amount of parent particles used in the simulation.

Start

The start frame of particle emission. You may set negative values, which enables you to start the simulation before the actual rendering.

End

The end frame of particle emission.

Lifetime

The lifetime (in frames) of the particles.

Random

A random variation of the lifetime of a given particle. The shortest possible lifetime is $Lifetime \times (1 - Rand)$. Values above 1.0 are not allowed. For example with the default Lifetime value of 50 a Random setting of 0.5 will give you particles with lives ranging from 50 frames to $50 \times (1.0 - 0.5) = 25$ frames, and with a Random setting of 0.75 you'll get particles with lives ranging from 50 frames to $50 \times (1.0 - 0.75) = 12.5$ frames.

Emission Location

Emit From parameters define how and where the particles are emitted, giving precise control over their distribution. You may use vertex groups to confine the emission, that is done in the Vertexgroups panel.

Verts

Emit particles from the vertices of a mesh.

Faces

Emit particles from the surface of a mesh's faces.

Volume

Emit particles from the volume of an enclosed mesh.

Distribution Settings

These settings control how the emissions of particles are distributed throughout the emission locations

Random

The emitter element indices are gone through in a random order instead of linearly (one after the other).

For Faces and Volume, additional options appear:

Even Distribution

Particle distribution is made even based on surface area of the elements, i.e. small elements emit less particles than large elements, so that the particle density is even.

Jittered

Particles are placed at jittered intervals on the emitter elements.

Particles/Face

Number of emissions per face (0 = automatic).

JitteringAmount

Amount of jitter applied to the sampling.

Random

Particles are emitted from random locations in the emitter's elements.

Grid

Particles are set in a 3d grid and particles near/in the elements are kept.

Invert Grid

Invert what is considered the object and what is not.

Hexagonal

Uses a hexagonal shaped grid instead of a rectangular one.

Resolution

Resolution of the grid.

Random

Add a random offset to grid locations.



Your mesh must be watertight to emit particles from the volume.

Some modifiers like Edge Split break up the surface, in which case volume emission will not work correctly!

Particle Physics

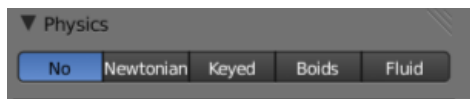


Image 1: Physics types.

The movement of particles may be controlled in a multitude of ways. With particles physics: there are five different systems:

None It doesn't give the particles any motion, which makes them belong to no physics system.

Newtonian Movement according to physical laws.

Keyed Dynamic or static particles where the (animated) targets are other particle systems.

Boids Particles with limited artificial intelligence, including behavior and rules programming, ideal for flocks of birds or schools of fishes, or predators vs preys simulations.

Fluid Movement according to fluid laws (based on Smoothed Particle Hydrodynamics technique).

Additional ways of moving particles:

- By softbody animation (only for Hair particle systems).
- By forcefields and along curves.
- By lattices.

Here we will discuss only the particle physics in the narrower sense, i.e. the settings in the Physics panel.

Velocity

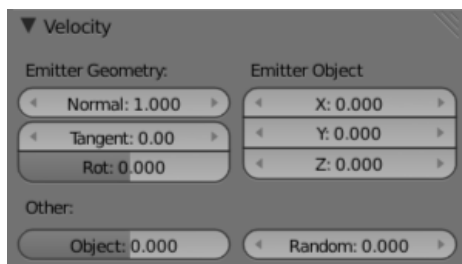


Image 3: Initial velocity.

The initial velocity of particles can be set through different parameters, based on the type of the particle system (see Particle System tab). If the particle system type is Emitter or Hair, then the following parameters give the particle an initial velocity in the direction of...

Emitter Geometry

Normal

The emitter's surface normals (i.e. let the surface normal give the particle a starting speed).

Tangent

Let the tangent speed give the particle a starting speed.

Rot

Rotates the surface tangent.

Emitter Object

Align X,Y,Z

Give an initial velocity in the X, Y, and Z axes.

Object

The emitter objects movement (i.e. let the object give the particle a starting speed).

Random

Gives the starting speed a random variation. You can use a texture to only change the value, see Controlling Emission, Interaction and Time).

Rotation

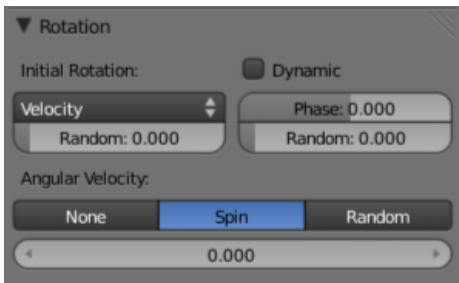


Image 4: Particles rotation.

These parameters specify how the individual particles are rotated during their travel. To visualize the rotation of a particle you should choose visualization type Axis in the Visualization panel and increase the Draw Size.

Initial Rotation Mode

Sets the initial rotation of the particle by aligning the x-axis in the direction of:

- None
 - the global x-axis.
- Normal
 - the emitter's surface normal.
- Velocity
 - the particle's initial velocity.
- Global X/Global Y/Global Z
 - one of the global axes
- Object X/Object Y/Object Z
 - one of the emitter object axes.

Random
Randomizes rotation.

Dynamic

If enabled, only initializes particles to the wanted rotation and angular velocity and let's physics handle the rest. Particles then change their angular velocity if they collide with other objects (like in the real world due to friction between the colliding surfaces). Otherwise the angular velocity is predetermined at all times (i.e. set rotation to dynamic/constant).

Phase

Initial rotation phase

Random

Rand allows a random variation of the Phase.

Angular Velocity

The magnitude of angular velocity, the dropdown specifies the axis of angular velocity to be

- None
 - a zero vector (no rotation).
- Spin
 - the particles velocity vector.
- Random
 - a random vector.

If you use a Curve Guide and want the particles to follow the curve, you have to set Angular Velocity to Spin and leave the rotation on Constant (i.e. don't turn on Dynamic). Curve Follow does not work for particles.

Common Physics Settings

Size

Sets the size of the particles.

Random Size

Give the particles a random size variation.

Mass

Specify the mass of the particles.

Multiply mass with particle size

Causes larger particles to have larger masses.

No Physics

At first a Physics type that makes the particles do nothing could seem a bit strange, but it can be very useful at times. None physics make the particles stick to their emitter their whole life time. The initial velocities here are for example used to give a velocity to

particles that are effected (or affected?) by a harmonic effector with this physics type when the effect of the effector ends.

Moreover, it can be very convenient to have particles at disposal (whose both Unborn and Died are visible on render) to groom vegetation and/or ecosystems using Object, Group or Billboard types of visualization.

Field Weights

The Field Weight Panel allows you to control how much influence each type of external force field, or effector, has on the particle system. Force fields are external forces that give dynamic systems motion. The force fields types are detailed on the [Force Field Page](#).

Effector Group

Limit effectors to a specified group. Only effectors in this group will have an effect on the current system.

Gravity

Control how much the Global Gravity has an effect on the system.

All

Scale all of the effector weights.

Force Fields

The Force Field Settings Panel allows you to make each individual act as a force field, allowing them to affect other dynamic systems, or even, each other.

Self Effect

Causes the particle force fields to have an effect on other particles within the same system.

Amount

Set how many of the particles act as force fields. 0 means all of them are effectors.

You can give particle systems up to 2 force fields. By default they do not have any. Choose an effector type from the dropdowns to enable them. Settings are described on the [Force Field Page](#).

Newtonian Physics

These are the “normal” particle physics. Particles start their life with the specified initial velocities and angular velocities, and move according to Newtonian forces. The response to environment and to forces is computed differently, according to any given integrator chosen by the animator.

Forces

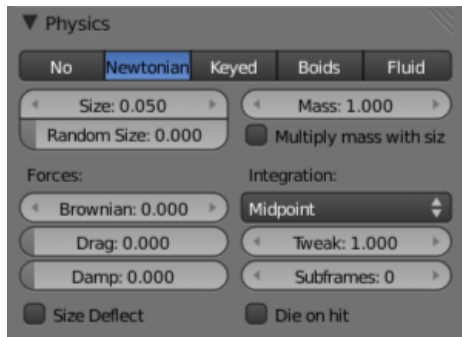


Image 5: Newtonian Physics.

Brownian

Specify the amount of Brownian motion. Brownian motion adds random motion to the particles based on a Brownian noise field. This is nice to simulate small, random wind forces.

Drag

A force that reduces particle velocity in relation to it's speed and size (useful in order to simulate Air-Drag or Water-Drag).

Damp

Reduces particle velocity (deceleration, friction, dampening).

Collision

Size Deflect

Use the particle size in deflections.

Die on Hit

Kill particle when it hits a deflector object.

Integration

Integrators are a set of mathematical methods available to calculate the movement of particles. The following guidelines will help to choose a proper integrator, according to the behavior aimed at by the animator.

Euler Also known as “Forward Euler”. Simplest integrator. Very fast but also with less exact results. If no dampening is used, particles get more and more energy over time. For example, bouncing particles will bounce higher and higher each time. Should not be confused with “Backward Euler” (not implemented) which has the opposite feature, energies decrease over time, even with no dampening. Use this integrator for short simulations or simulations with a lot of dampening where speedy calculations is more important than accuracy.

Varlet Very fast and stable integrator, energy is conserved over time with very little numerical dissipation.

Midpoint Also known as “2nd order Runge-Kutta”. Slower than Euler but much more stable. If the acceleration is constant (no drag for example), it is energy conservative. It should be noted that in example of the bouncing particles, the particles might bounce higher than they started once in a while, but this is not a trend. This integrator is a generally good integrator for use in most cases.

RK4 Short for “4th order Runge-Kutta”. Similar to Midpoint but slower and in most cases more accurate. It is energy conservative even if the acceleration is not constant. Only needed in complex simulations where Midpoint is found not to be accurate enough.

Timestep

The simulation time step per frame.

Subframes

Subframes to simulate for improved stability and finer granularity in simulations. Use higher values for faster moving particles.

Keyed Particles

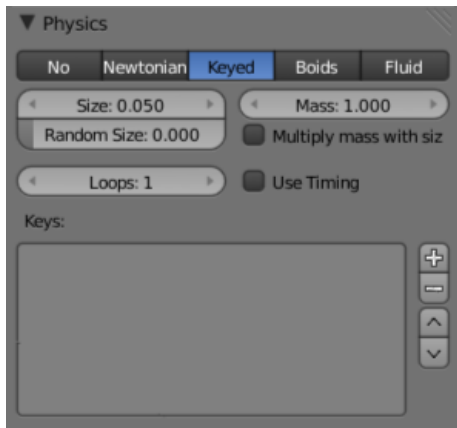


Image 6: Keyed Physics.

The particle paths of keyed particles are determined from the emitter to another particle system's particles. This allows creation of chains of systems with keyed physics to create long strands or groovy moving particles. Basically the particles have no dynamics but are interpolated from one system to the next at drawtime. Because you have so much control over these kind of systems, you may use it

For example, for machines handling fibers (animation of a loom, ...). In (Image 3), the strands flow from the bottom system (First keyed) to the second keyed system in the middle, and from that to the top system that has None-Physics. Since you may animate each emitter object as you like, you can do arbitrarily complex animations.

Setup

To setup Keyed particles you need at least two particle systems.

The first system has keyed physics, and it needs the option First activated. This will be the system that is visible. *The second system may be another keyed system but without the option First, or a normal particle system. This second system is the target of the keyed system.

Loops

Sets the number of times the keys are looped. Disabled if Use Timing is enabled.

Keys

Key Targets

You have to enter the name of the object which bears the target system and if there are multiple particle systems the number of the system.

Click the  to add a key, then select the object.

If you use only one keyed system the particles will travel in their lifetime from the emitter to the target. A shorter lifetime means faster movement. If you have more than one keyed system in a chain, the lifetime will be split equally. This may lead to varying particle speeds between the targets.

Timing

Use Timing

Timing works together with the Time slider for the other keyed systems in a chain. The Time slider allows to define a fraction of particle lifetime for particle movement.

An example: let's assume that you have two keyed systems in a chain and a third system as target. The particle lifetime of the first system shall be 50 keys. The particles will travel in 25 frames from the first keyed system to the second, and in further 25 frames from the second system to the target. If you use the Timed button for the first system, the Time slider appears in the second system's panel. Its default value is 0.5, so the time is equally split between the systems. If you set Time to 1, the movement from the first system to the second will get all the lifetime (the particles will die at the second system).

If you set Time to 0 the particles will start at the second system and travel to the target.

Boids



Image 7: Boid Physics.

Boids particle systems can be set to follow basic rules and behaviors. They are useful for simulating flocks, swarms, herds and schools of various kind of animals, insects and fishes. They can react on the presence of other objects and on the members of their own system. Boids can handle only a certain amount of information, therefore the sequence of the Behaviour settings is very important. In certain situations only the first three parameter are evaluated.

To view the subpanel to the right, add a Particle System of type Emitter and look in the middle area of the Particle System tab.

Physics

Boids try to avoid objects with activated Deflection. They try to reach objects with positive Spherical fields, and fly from objects with negative Spherical fields. The objects have to share one common layer to have effect. It is not necessary to render this common layer, so you may use invisible influences.

Boids can different physics depending on whether they are in the air, or on land(on collision object)

Allow Flight

Allow boids to move in the air.

Allow Land

Allow boids to move on land.

Allow Climbing

Allow boids to climb goal objects.

Max Air Speed

Set the Maximum velocity in the air.

Min Air Speed

Set the Maximum velocity in the air.

Max Air Acceleration

Lateral acceleration in air, percent of max velocity (turn). Defines how fast a boid is able to change direction.

Max Air Angular Velocity

Tangential acceleration in air, percent 180 degrees. Defines how much the boid can suddenly accelerate in order to fulfill a rule.

Air Personal Space

Radius of boids personal space in air. Percentage of particle size.

Landing Smoothness

How smoothly the boids land.

Max Land Speed

Set the Maximum velocity on land.

Jump Speed
Maximum speed for jumping

Max Land Acceleration
Lateral acceleration on land, percent of max velocity (turn). Defines how fast a boid is able to change direction.

Max Land Angular Velocity
Tangential acceleration on land, percent 180 degrees. Defines how much the boid can suddenly accelerate in order to fulfill a rule.

Land Personal Space
Radius of boids personal space on land. Percentage of particle size.

Land Stick Force
How strong a force must be to start effecting a boid on land.

Banking
Amount of rotation around velocity vector on turns. Banking of (1.0 == natural banking).

Pitch
Amount of rotation around side vector.

Height
Boid height relative to particle size.

Battle

Health
Initial boid health when born.

Strength
Maximum caused damage per second on attack.

Aggression
Boid will fight this times stronger than enemy.

Accuracy
Accuracy of attack.

Range
Maximum distance of which a boid can attack.

Alliance

The relations box allows you to set up other particle systems to react with the boids. Setting the type to Enemy will cause the systems to fight with each other. Friend will make the systems work together. Neutral will not cause them to align or fight with each other.

Deflectors and Effectors

As mentioned before, very much like Newtonian particles, Boids will react to the surrounding deflectors and fields, according to the needs of the animator:

Deflection: Boids will try to avoid deflector objects according to the Collision rule's weight. It works best for convex surfaces (some work needed for concave surfaces). For boid physics, Spherical fields define the way the objects having the field are seen by others. So a negative Spherical field (on an object or a particle system) will be a predator to all other boids particle systems, and a positive field will be a goal to all other boids particle systems.

When you select an object with a particle system set on, you have in the Fields tab a little menu stating if the field should apply to the emitter object or to the particle system. You have to select the particle system name if you want prey particles to flee away from predator particles.

Spherical fields: These effectors could be predators (negative Strength) that boids try to avoid or targets (positive Strength) that boids try to reach according to the (respectively) Avoid and Goal rules' weights. Spherical's effective Strength is multiplied by the actual relevant weight (e.g. if either Strength or Goal is null, then a flock of boids won't track a positive Spherical field). You can also activate Die on hit (Extras panel) so that a prey particle simply disappears when "attacked" by a predator particle which reaches it. To make this work, the predator particles have to have a spherical field with negative force, it is not sufficient just to set a positive goal for the prey particles (but you may set the predators force strength to -0.01). The size of the predators and the prey can be set with the Size button in the Extras panel.

Boid Brain

The Boid Brain panel controls how the boids particles will react with each other. The boids' behavior is controlled by a list of rules. Only a certain amount of information in the list can be evaluated. If the memory capacity is exceeded, the remaining rules are ignored.

The rules are by default parsed from top-list to bottom-list (thus giving explicit priorities), and the order can be modified using the little arrows buttons on the right side.

The list of rules available are:

- Goal
 - Seek goal (objects with Spherical fields and positive Strength)
- Predict
 - Predict target's movements
- Avoid
 - Avoid "predators" (objects with Spherical fields and negative Strength)
- Predict
 - Predict target's movements
- Fear Factor
 - Avoid object if danger from it is above this threshold
- Avoid Collision
 - Avoid objects with activated Deflection
- Boids
 - Avoid collision with other boids
- Deflectors
 - Avoid collision with deflector objects
- Look Ahead
 - Time to look ahead in seconds
- Separate
 - Boids move away from each other
- Flock
 - Copy movements of neighboring boids, but avoid each other
- Follow Leader
 - Follows a leader object instead of a boid
- Distance
 - Distance behind leader to follow
- Line
 - Follow the leader in a line
- Average Speed
 - Maintain average velocity.
- Speed
 - Percentage of maximum speed
- Wander
 - How fast velocity's direction is randomized
- Level
 - How much velocity's Z component is kept constant
- Fight
 - Move toward nearby boids
- Fight Distance
 - Attack boids at a maximum of this distance
- Flee Distance
 - Flee to this distance

Rule Evaluation

There are three ways control how rules are evaluated.

Average
All rules are averaged.

Random
A random rule is selected for each boid.

Fuzzy
Uses fuzzy logic to evaluate rules. Rules are gone through top to bottom. Only the first rule that effect above fuzziness threshold is evaluated. The value should be considered how hard the boid will try to respect a given rule (a value of 1.000 means the Boid will always stick to it, a value of 0.000 means it will never). If the boid meets more than one conflicting condition at the same time, it will try to fulfill all the rules according to the respective weight of each.

Please note that a given boid will try as much as it can to comply to each of the rules he is given, but it is more than likely that some rule will take precedence on other in some cases. For example, in order to avoid a predator, a boid could probably "forget" about

Collision, Crowd and Center rules, meaning that “while panicked” it could well run into obstacles, for example, even if instructed not to, most of the time.

As a final note, the Collision algorithm is still not perfect and in research progress, so you can expect wrong behaviors at some occasion. It is worked on.

Fluid Physics

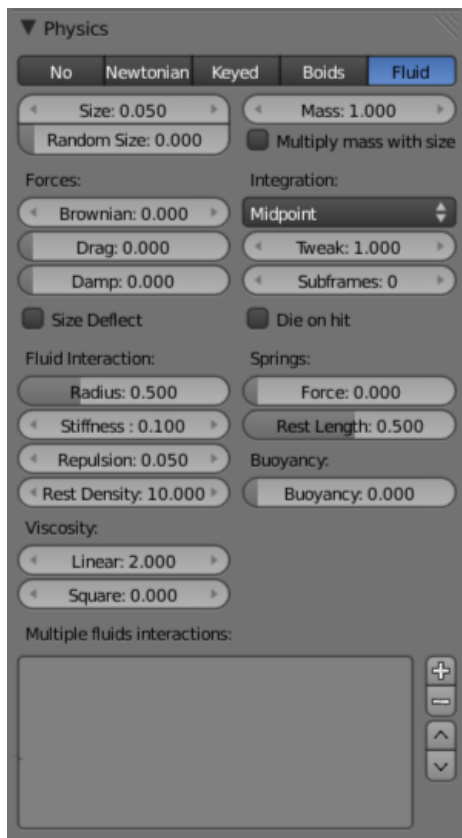


Image 8: Fluid Physics.

Fluid simulations are widely used in CG, and a very desired feature of any particle system, fluid particles are similar to newtonian ones but this time particles are influenced by internal forces like pressure, surface tension, viscosity, springs, etc. Blender particle fluids use the SPH techniques to solve the particles fluid equations.

Smoothed-particle hydrodynamics (SPH) is a computational method used for simulating fluid flows. It has been used in many fields of research, including astrophysics, ballistics, vulcanology, and oceanography. It is a mesh-free Lagrangian method (where the co-ordinates move with the fluid), and the resolution of the method can easily be adjusted with respect to variables such as the density.

From liquids to slime, goo to sand and wispy smoke the possibilities are endless.

Settings

Fluid physics share options with [Newtonian Physics](#). These are covered on that page.

Fluid Properties

Stiffness

How incompressible the fluid is.

Viscosity

Linear viscosity. Use lower viscosity for thicker fluids.

Buoyancy

Artificial buoyancy force in negative gravity direction based on pressure differences inside the fluid.

Advanced

Repulsion Factor

How strongly the fluid tries to keep from clustering (factor of stiffness). Check box sets repulsion as a factor of stiffness.

Stiff Viscosity

Creates viscosity for expanding fluid. Check box sets this to be a factor of normal viscosity.

Interaction Radius

Fluid's interaction radius. Check box sets this to be a factor of 4*particle size.

Rest Density

Density of fluid when at rest. Check box sets this to be a factor of default density.

Springs

Force

Spring force

Rest Length

Rest length of springs. Factor of particle radius. Check box sets this to be a factor of 2*particle size.

Viscoelastic Springs

Use viscoelastic springs instead of Hooke's springs.

Elastic Limit

How much the spring has to be stretched/compressed in order to change its rest length

Plasticity

How much the spring rest length can change after the elastic limit is crossed.

Initial Rest Length

Use initial length as spring rest length instead of 2*particle size.

Frames

Create springs for this number of frames since particle's birth (0 is always).

Page status ([reviewing guidelines](#))

Images

Images from 2.4

Proposed fixes: none

Particle Visualization

With the items in the Display and Render panel you can set the way the particles will be rendered or depicted in the view ports in various ways. Some options are valid only for the 3D window, the particles then are rendered always as [Halos](#). Some of the options will be rendered as shown in the 3D window.

Viewport Display

The Display Panel controls how particles are displayed in the 3d viewport. This does not necessarily determine how they will appear when rendered.

None

The particles are not shown in the 3D window and are not rendered. The emitter may be rendered though.

Point

Particles are displayed as square points. Their size is independent of the distance from the camera.

Circle

Particles are displayed as circles that face the view. Their size is independent of the distance from the camera.

Cross

Particles are displayed as 6-point crosses that align to the rotation of the particles. Their size is independent of the distance from the camera.

Axis

Particles are displayed as 3-point axes. This is useful if you want to see the orientation and rotation of particles in the view port. Increase the Draw Size until you can clearly distinguish the axis.

Particles visualized like Point, Circle, Cross and Axis don't have any special options, but can be very useful when you have multiple particle systems at play, if you don't want to confuse particles of one system from another (e.g. in simulations using Boids physics).

Display

Specifies the percentage of all particles to show in the viewport (all particles are still rendered).

Draw Size

Specifies how large (in pixels) the particles are drawn in the viewport (0 = default).

Size

Draw the size of the particles with a circle.

Velocity

Draw the velocity of the particles with a line that points in the direction of motion, and length relative to speed.

Number

Draw the id-numbers of the particles in the order of emission.

Color

The Color Menu allows you to draw particles according to certain particle properties.

None

Particles are black.

Material

Particles are colored according to the material they are given.

Velocity

Color particles according to their speed. The color is a ramp from blue to green to red, Blue being the slowest, and Red being velocities approaching the value of Max or above. Increasing Max allows for a wider range of particle velocities.

Acceleration

Color particles according to their acceleration.

Render Settings

The Render Panel controls how particles appear when they are rendered.

Material Index

Set which of the object's material is used to shade the particles.

Parent

Use a different object's coordinates to determine the birth of particles.

Emitter

When disabled, the emitter is no longer rendered. Activate the button Emitter to also render the mesh.

Parents

Render also parent particles if child particles are used. Children have a lot of different deformation options, so the straight parents would stand between their curly children. So by default Parents are not rendered if you activate Children.. See [Children](#)

Unborn

Render particles before they are born.

Died

Render particles after they have died. This is very useful if particles die in a collision (Die on hit), so you can cover objects with particles.

None

When set to None particles are not rendered. This is useful if you are using the particles to duplicate objects.

Halo

Halo particles are rendered as [Halo Type Materials](#).

Trail Count

Set the number of trail particles. When greater than 1, additional options appear.

Length in Frames

Path timing is in absolute frames.

Length

End time of drawn path.

Random

Give path lengths a random variation.

Line

The Line visualization mode creates (more or less thin) polygon lines with the strand renderer in the direction of particles velocities. The thickness of the line is set with the parameter Start of the Strands shader (Material sub-context, Links and Pipeline panel).

Back

Set the length of the particle's tail.

Front

Set the length of the particle's head.

Speed

Multiply the line length by particles' speed. The faster, the longer the line.

Trail Count

See description in the [Halo Render Type](#) above.

Path

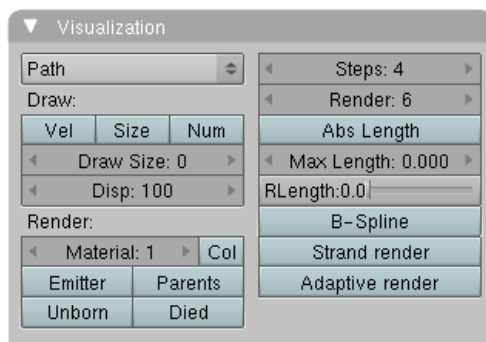


Image 3: The Visualization panel for Path visualization.

The Path visualization needs a [Hair](#) particle system or [Keyed](#) particles.

Strand render

[Keypointstrands] Use the strand primitive for rendering. Very fast and effective render.

Adaptive render

Tries to remove unnecessary geometry from the paths before rendering particle strands in order to make the render faster and easier on memory.

Angle

How many degrees path has to curve to produce another render segment (straight parts of paths need fewer segments).

Pixel

How many pixels path has to cover to produce another render segment (very short hair or long hair viewed from far away need fewer parts). (only for Adaptive render).

B-Spline

Interpolate hair using B-Splines. This may be an option for you if you want to use low Render values. You loose a bit of control but gain smoother paths.

Steps

Set the number of subdivisions of the rendered paths (the value is a power of 2). You should set this value carefully, because if you increase the render value by two you need four times more memory to render. Also the rendering is faster if you use low render values (sometimes drastically). But how low you can go with this value depends on the waviness of the hair. (the value is a power of 2). This means 0 steps give 1 subdivision, 1 give 2 subdivisions, 2→4, 3→8, 4→16, ... $n \rightarrow 2^n$.

Timing Options:

Absolute Path Time

Path timing is in absolute frames.

Start

Start time of the drawn path.

End

End time of the drawn path.

Random

Give the path length a random variation.

Please see also the manual page about [Strands](#) for an in depth description.

Object

In the Object visualization mode the specified object (Dupli Object: field) is duplicated in place of each particle. The duplicated object has to be at the center of the coordinate system, or it will get an offset to the particle.

Global

Use object's global coordinates for duplication.

Size

Size of the objects

Random Size

Give the objects a random size variation.



Group

In the Group visualization mode, the objects that belong to the group (GR: field) are duplicated sequentially in the place of the particles.

WholeGroup

Use the whole group at once, instead of one of its elements, the group being displayed in place of each particle.

Use Count

Use objects multiple times in the same groups. Specify the order and number of times to repeat each object with the list box that appears. You can duplicate an object in the list with the  button, or remove a duplicate with the  button.

Use Global

Use object's global coordinates for duplication.

Pick Random

The objects in the group are selected in a random order, and only one object is displayed in place of a particle.

Please note that this mechanism fully replaces old Blender particles system using parentage and DupliVerts to replace particles with actual geometry. This method is fully deprecated and doesn't work anymore.

Size

Size of the objects

Random Size

Give the objects a random size variation.

Billboard

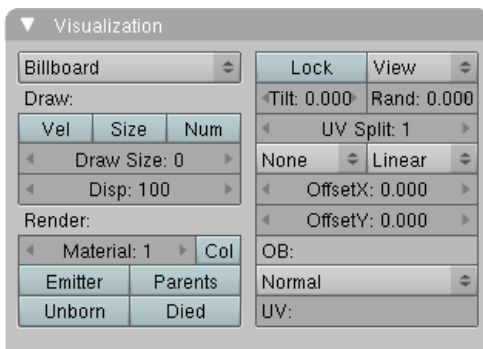


Image 4: Billboard visualization for particles.

Billboards are aligned square planes. They are aligned to the camera by default, but you can choose another object that they should be aligned to.

If you move a billboard around it's target, it always faces the center of it's target. The size of a billboard is set with the parameter Size of the particle (in Blender Units). You can use them e.g. for [Sprites](#), or to replace Halo visualization. Everything that can be done with a halo can also be done with a billboard. But billboards are real objects, they are seen by raytracing, they appear behind transparent objects, they may have an arbitrary form and receive light and shadows. They are a bit more difficult to set up and take more render time and resources.

Texturing billboards (including animated textures with alpha) is done by using uv coordinates that are generated automatically for them so they can take an arbitrary shape. This works well for animations, because the alignment of the billboards can be dynamic. The textures can be animated in several ways:

- Depending on the particle lifetime (relative time).
- Depending on the particle starting time.
- Depending on the frame (absolute time).

You can use different sections of an image texture:

- Depending on the lifetime of the billboard.
- Depending on the emission time.
- Depending on align or tilt.

Since you use normal materials for the billboard you have all freedoms in mixing textures to your liking. The material itself is animated in absolute time.

The main thing to understand is that if the object doesn't have any *UV Layers*, you need to create at least one in the objects Editing context, for any of these to work. Moreover, the texture has to be set to UV coordinates in the Map Input panel. If you want to see examples for some of the animation possibilities, see the [Billboard Animation Tutorial](#).

An interesting alternative to billboards are in certain cases strands, because you can animate the shape of the strands. Because this visualization type has so much options it is explained in greater detail below.

You can limit the movement with these options. How the axis is prealigned at emission time.

View

No prealignment, normal orientation to the target.

X/Y/Z

Along the global X/Y/Z-axis respectively.

Velocity

Along the speed vector of the particle.

Lock

Locks the align axis, keeps this orientation, the billboard aligns only along one axis to it's target

Billboard Object

The target object that the billboards are facing. By default, the active camera is used.

Tilt Angle

Rotation angle of the billboards planes. A tilt of 1 rotates by 180 degrees (turns the billboard upside down).

Random

Random variation of tilt.

Offset X

Offset the billboard horizontally in relation to the particle center, this does not move the texture.

Offset Y

Offset the billboard vertically in relation to the particle center.

UV Channels

Billboards are just square polygons. To texture them in different ways we have to have a way to set what textures we want for the billboards and how we want them to be mapped to the squares. These can then be set in the texture mapping buttons to set

wanted textures for different coordinates. You may use three different UV layers and get three different sets of UV coordinates, which can then be applied to different (or the same) textures.

Billboard Normal UV

Coordinates are the same for every billboard, and just place the image straight on the square.

Billboard Time-Index (X-Y)

Coordinates actually define single points in the texture plane with the x-axis as time and y-axis as the particle index. For example using a horizontal blend texture mapped to color from white to black will give us particles that start off as white and gradually change to black during their lifetime. On the other hand a vertical blend texture mapped to color from white to black will make the first particle to be white and the last particle to be black with the particles in between a shade of gray.

The animation of the UV textures is a bit tricky. The UV texture is split into rows and columns (N times N). The texture should be square. You have to use UV Split in the UV channel and fill in the name of the UV layer. This generated UV coordinates for this layer.

Split UV's

The amount of rows/columns in the texture to be used.

Coordinates are a single part of the UV Split grid, which is a $n \times n$ grid over the whole texture. What the part is used for each particle and at what time is determined by the Offset and Animate controls. These can be used to make each billboard unique or to use an "animated" texture for them by having each frame of the animation in a grid in a big image.

Billboard Split UV

Set the name of the *UV layer* to use with billboards (you can use a different one for each UV Channel). By default, it is the active UV layer (check the Mesh panel in the Editing context, F9).

Animate

Dropdown menu, indicating how the split UVs could be animated (changing from particle to particle with time):

None

No animation occurs on the particle itself, the billboard uses one section of the texture in it's lifetime.

Age

The sections of the texture are gone through sequentially in particles' lifetimes.

Angle

Change the section based on the angle of rotation around the Align to axis, if View is used the change is based on the amount of tilt.

Frame

The section is changes according to the frame.

Offset

Specifies how to choose the first part (of all the parts in the $n \times n$ grid in the texture defined by the UV Split number) for all particles.

None

All particles start from the first part.

Linear

First particle will start from the first part and the last particle will start from the last part, the particles in between will get a part assigned linearly from the first to the last part.

Random

Give a random starting part for every particle.

Trail Count

See the description in the [Halo Render Type](#) above.

Page status ([reviewing guidelines](#))

Partial page Text Some of the information is incorrect

Proposed fixes: [X](#)

done

Cache

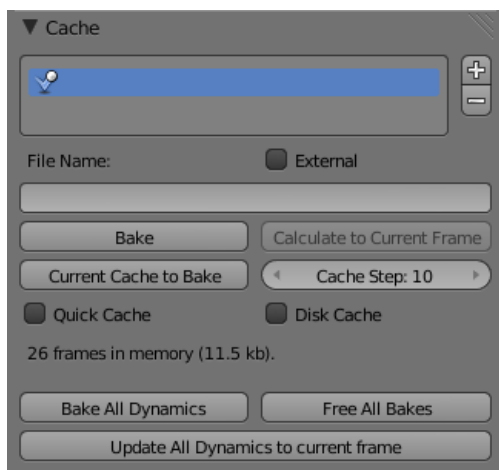


Image 4: Cache panel for particles.

Emitter systems use a unified system for caching and baking (together with softbody and cloth). The results of the simulation are automatically cached to disk when the animation is played, so that the next time it runs, it can play again quickly by reading in the results from the disk. If you Bake the simulation the cache is protected and you will be asked when you're trying to change a setting that will make a recalculating necessary.



Beware of the Start and End Settings

The simulation is only calculated for the positive frames in-between the Start and End frames of the Bake panel, whether you bake or not. So if you want a simulation longer than 250 frames you have to change the End frame!

Caching

- As animation is played, each physics system writes each frame to disk, between the simulation start and end frames. These files are stored in folders with prefix "blendcache", next to the .blend file. Note that for the cache to fill up, one has to start playback before or on the frame that the simulation starts.
- The cache is cleared automatically on changes - but not on all changes, so it may be necessary to free it manually e.g. if you change a force field.
- If it is impossible to write in the subdirectory there will be no caching.
- The cache can be freed per physics system with a button in the panels, or with the CtrlB shortcut key to free it for all selected objects.
- If the file path to the cache is longer than what is possible with your operating system (more than 250 characters for example), strange things might happen.

Baking

- The system is protected against changes after baking.
- The Bake result is cleared also with CtrlB for all selected objects or click on Free Bake for a singular particle system.
- If the mesh changes the simulation is not calculated anew.
- Sorry: no bake editing for particles like for softbodies and clothes.

Two notes at the end:

- For renderfarms, it is best to bake all the physics systems, and then copy the blendcache to the renderfarm as well.
- Be careful with the sequence of modifiers in the modifier stack (as always). You may have a different number of faces in the 3D

window and for rendering (e.g. when using subdivision surface), if so, the rendered result may be very different from what you see in the 3D window.

Hair

When set to hair mode, particle system creates only static particles, which may be used for hair, fur, grass and the like.

Growing

The first step is to create the hair, specifying the amount of hair strands and their lengths.

The complete path of the particles is calculated in advance. So everything a particle does a hair may do also. A hair is as long as the particle path would be for a particle with a lifetime of 100 frames. Instead of rendering every frame of the particle animation point by point there are calculated control points with an interpolation, the segments.

Styling

The next step is to style the hair. You can change the look of base hairs by changing the [Physics Settings](#).

A more advanced way of changing the hair appearance is to use [Children](#). This adds child hairs to the original ones, and has settings for giving them different types of shapes.

You can also interactively style hairs in [Particle Mode](#). In this mode, the particle settings become disabled, and you can comb, trim, lengthen, etc. the hair curves.

Animating

Hair can now be made dynamic using the cloth solver. This is covered in the [Hair Dynamics](#) page.

Rendering

Blender can render hairs in several different ways. Materials have a Strand section, which is covered in the materials section in the [Strands Page](#).

Hair can also be used as a basis for the [Particle Instance modifier](#), which allows you to have a mesh be deformed along the curves, which is useful for thicker strands, or things like grass, or feathers, which may have a more specific look.

Options

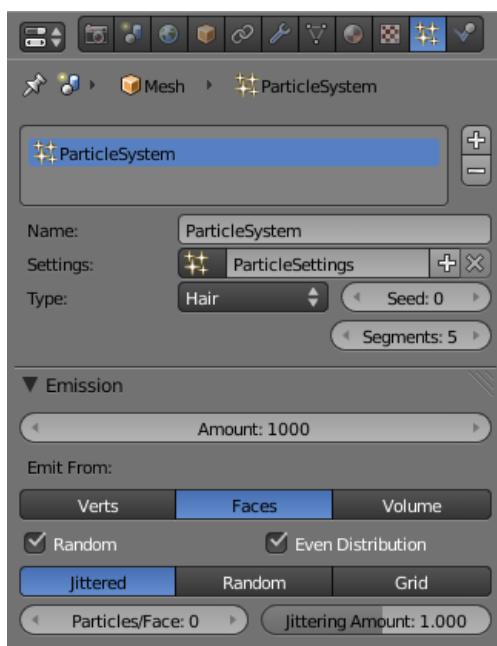


Image 4a: Settings for a Hair particle system.

Regrow

Regrow Hair for each frame.

Advanced

Enables advanced settings which reflect the same ones as working in Emitter mode.

Emission

Amount

Set the amount of hair strands. Use as little particles as possible, especially if you plan to use softbody animation later. But you need enough particles to have good control. For a “normal” haircut I found some thousand (very roughly 2000) particles to give enough control. You may need a lot more particles if you plan to cover a body with fur. Volume will be produced later with Children.

Hair Dynamics

Settings for adding movement to hair see [Hair Dynamics](#).

Display

Rendered

Draw hair as curves.

Path

Draw just the end points of the hairs.

Steps

The number of segments (control points minus 1) of the hair strand. In between the control points the segments are interpolated. The number of control points is important:

- for the softbody animation, because the control points are animated like vertices, so more control points mean longer calculation times.
- for the interactive editing, because you can only move the control points (but you may recalculate the number of control points in Particle Mode).

10 Segments should be sufficient even for very long hair, 5 Segments are enough for shorter hair, and 2 or 3 segments should be enough for short fur.

Children

See [Children](#).

Render

Hair can be rendered as a Path, Object, or Group. See [Particle Visualization](#) for descriptions.

Usage



Image 4b: Particle systems may get hairy...

- [Fur Tutorial](#), which produced (*Image 4b*). It deals especially with short hair.

Hair Dynamics

Hair particles can now be made dynamic using Cloth physics.

To enable hair physics, click the check box beside Hair Dynamics.

Settings

Material

Stiffness

Controls how stiff the root of the hair strands are.

Mass

Controls the mass of the cloth material.

Bending

Controls the amount of bend along the hairs. Higher values cause less bending.

Internal Friction

Amount of friction between individual hairs.

Collider Friction

Amount of friction between hairs and external collision objects.

Damping

Spring

Damping of cloth velocity. (higher = more smooth, less jiggling).

Air

Air has normally some thickness which slows falling things down.

Quality

Steps

Quality of the simulation in steps per frame. (higher is better quality but slower).

Children

Children are Hair and Keyed particles assigned subparticles. They make it possible to work primarily with a relatively low amount of Parent particles, for whom the physics are calculated. The children are then aligned to their parents. Without recalculating the physics the number and visualization of the children can be changed.

- Children can be emitted from particles or from faces (with some different options). Emission from Faces has some advantages, especially the distribution is more even on each face (which makes it better suitable for fur and the like). However, children from particles follow their parents better, e.g. if you have a softbody animation and don't want the hair to penetrate the emitting mesh. But see also our manual page about [Hair](#).
- If you turn on children the parents are no longer rendered (which makes sense because the shape of the children may be quite different from that of their parents). If you want to see the parents additionally turn on the Parents button in the Visualization panel.
- Children carry the same material as their parents and are colored according to the exact place from where they are emitted (so all children may have different color or other attributes).

The possible options depend from the type of particle system, and if you work with *Children from faces* or *Children from particles*. We don't show every possible combination, only the settings for a Hair particle system.

Settings

Simple

Children are emitted from the parent hairs.

Interpolated

Children are emitted between the *Parent* particles on the faces of a mesh. They interpolate between adjacent parents. This is especially useful for fur, because you can achieve an even distribution. Some of the children can become virtual parents, which are influencing other particles nearby.

Display

The number of children in the 3D window.

Render

The number of children to be rendered (up to 10.000).

For Simple Mode

Size

Only for Emitter. A multiplier for children size.

Random

Random variation to the size of child particles.

Interpolated Mode

Seed

Offset the random number table for child particles, to get a different result.

Virtual

Relative amount of virtual parents.

Long Hair

Calculate children that suit long hair well.

Effects

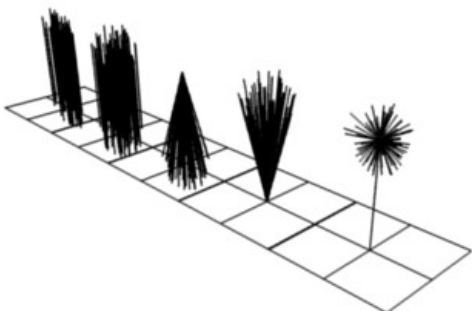


Image 2: From left to right: Round: 0.0 / Round: 1.0 /

Clump: 1.0 / Clump: -1.0 / Shape: -0.99.

Clump

Clumping. The children may meet at their tip (1.0) or start together at their root (-1.0).

Shape

Form of Clump. Either inverse parabolic (0.99) or exponentially (-0.99).

Length

Length of child paths

Threshold

Amount of particles left untouched by child path length

Radius

The radius in which the children are distributed around their parents. This is 3D, so children may be emitted higher or lower than their parents.

Roundness

The roundness of the children around their parents. Either in a sphere (1.0) or in-plane (0.0).

Seed

Offset in the random number table for child particles, to get a different randomized result

Roughness

Uniform,Size

It is based on children location so it varies the paths in a similar way when the children are near.

Endpoint,Shape

"Rough End" randomizes path ends (a bit like random negative clumping). Shape may be varied from <1 (parabolic) to 10.0 (hyperbolic).

Random,Size,Threshold

It is based on a random vector so it's not the same for nearby children. The threshold can be specified to apply this to only a part of children. This is useful for creating a few stray children that won't do what others do.

Kink

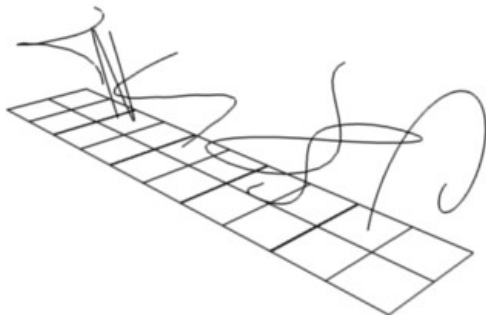


Image 3: Child particles with Kink. From left to right: Curl / Radial / Wave / Braid / Roll.

With Kink you can rotate the children around the parent. See above picture (*Image 3*) for the different types of Kink.

Curl

Children grow in a spiral around the parent hairs.

Radial

Children form around the parent a wave shape that passes through the parent hair.

Wave

Children form a wave, all in the same direction.

Braid

Children braid themselves around the parent hair.

Amplitude

The amplitude of the offset.

Clump

How much clump effects kink amplitude.

Flatness

How flat the hairs are.

Frequency

The frequency of the offset ($1/\text{total length}$). The higher the frequency the more rotations are done.

Shape

Where the rotation starts (offset of rotation).

Page status ([reviewing guidelines](#))

Partial page

Proposed fixes: none

Vertex Groups

The Vertexgroups panel allows you to specify vertex groups to use for several child particle settings. You can also negate the effect of each vertex group with the check boxes. You can affect the following attributes:

- Density
- Length
- Clump
- Kink
- Roughness 1
- Roughness 2
- Roughness End

Examples

...

Particle Mode

Using Particle Mode you can edit the key-points (key-frames) and paths of Baked [Hair](#), [Particle](#), [Cloth](#), and [Soft Body](#) simulations. (You can also edit and style hair before baking).

Since working in particle mode is pretty easy and very similar to working with vertices in the 3D window, we will show how to set up a particle system and then give a reference of the various functions.

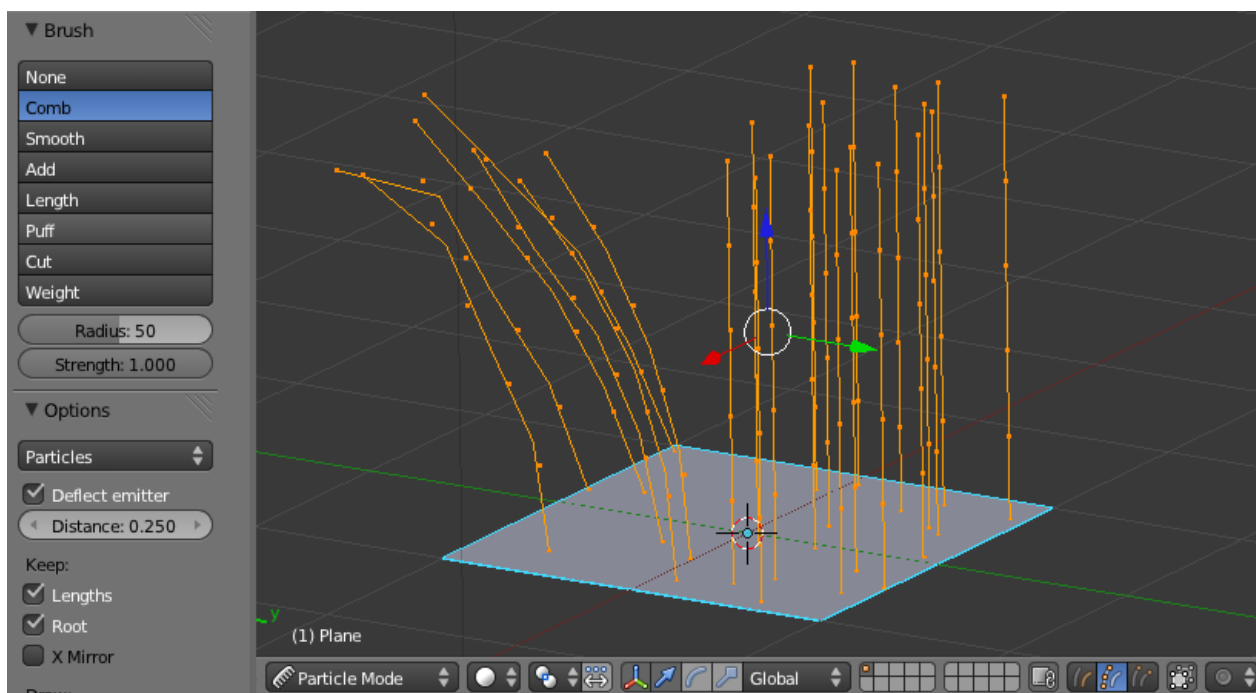
Ways to use Particle Mode

Only Frames Baked to Memory are Editable!

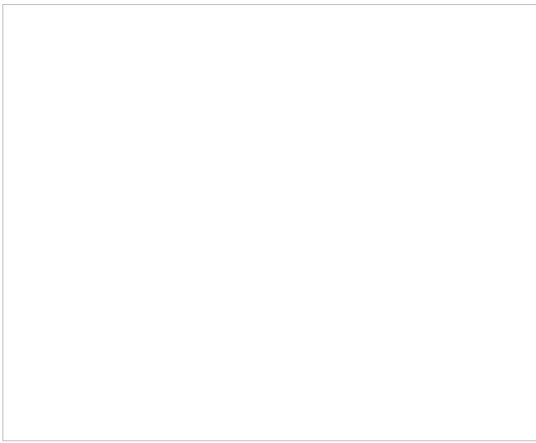
If you cannot edit the particles, check that you are not baking to a [Disk Cache](#).

Setup for Hair Particles

- Create a Hair particle system - With your object selected, click the Particle System icon in the Properties panel. Create a new particle system by clicking the Plus.
- Give it an initial velocity in the Normal direction (first check the Advanced box, then modify the Velocity sub-panel), or adjust the Hair Length.
- Create a simulation - Place the camera at a good position (» View » Cameras » Active Camera ... or 0 NumPad). Check the Hair Dynamics box. Select » Render » Render OpenGL Animation in Render Engine mode.



Editing hair strands in Particle Mode



Editing a baked particle simulation's particle paths in Particle Mode

Setup for Particle, Cloth, and Soft Body Simulations

- Use Emitter particles, or a cloth/soft-body simulation
- Create a simulation - set up objects and or emitters, set your time range (use a small range if you are just starting out and experimenting), set up the simulation how you want it, using Alt+a to preview it.

Bake the Simulation

- Once you are happy with the general simulation, [bake](#) the simulation from object mode. The simulation must be baked to enable editing. (remember to bake to memory, a disk cache will not be editable in Particle Mode)

Edit the Simulation

- Switch to Particle Mode from the Mode dropdown menu in the bottom menu bar of the 3D View to edit the particle's paths/keyframes. You may need to press T from within the 3D viewport to see the Particle Mode panel. Move to the frame you want to edit and use the various Particle Mode tools to edit your simulation. Work slowly, previewing your changes with Alt+a, and save often so that you can go back to the previous version should something happen, or that you do not like the latest changes you have made.

To be able to clearly see what you are working on:

- Turn on the Particle Edit Properties (*PEP*) panel with N.
- Select Point select mode



in the header of the 3D window. This will display key points along the particle path.




Brush Size

Press F to resize the brush while working

Using Particle Mode

Selecting Points

- Single: RMB .
- All: A.
- Linked: Move the mouse over a keypoint and press L.
- Border select: B.
- First/last: W → Select First/Select Last.

You may also use the Select Menu.



Selections

Selections are extremely useful for modifying only the particles that you want. Hover over a particle path and press L to link-

select it, hover over the next and press L to add that path to the selection. To remove a path, hold shift and press L. To Deselect all press A. The method to select individual points is the same as in edit mode. click to select, shift+click to add/remove a point from the selection

Beware of Undo!

Using Undo in Particle Mode can have strange results. Remember to save often!

Moving keypoints or particles

- To move selected keypoints press G, or use one of the various other methods to grab vertices.
- To move a particle root you have to turn off Keep Root in the Tool Bar.
- You can do many of the things like with vertices, including scaling, rotating and removing (complete particles or single keys).
- You may not duplicate or extrude keys or particles, but you can subdivide particles which adds new keypoints (W → Subdivide/2 NumPad).
- Alternatively you can rekey a particle (W → Rekey/1 NumPad) and choose the number of keys.

How smoothly the hair and particle paths are displayed depends on the Path Steps setting in the Tool Bar. Low settings produce blocky interpolation between points, while high settings produce a smooth curve.

Mirroring particles

- If you want to create an X-Axis symmetrical haircut you have to do following steps:
 - Select all particles with A.
 - Mirror the particles with CtrlM, or use the Particle → Mirror menu.
 - Turn on X-Axis Mirror Editing in the Particle menu.

It may happen that after mirroring two particles occupy nearly the same place. Since this would be a waste of memory and rendertime, you can Remove doubles either from the Specials (W) or the Particle menu.

Hiding/Unhiding

Hiding and unhiding of particles works similar as with vertices in the 3D window. Select one or more keypoints of the particle you want to hide and press H. The particle in fact doesn't vanish, only the key points.

Hidden particles (i.e. particles whose keypoints are hidden) don't react on the various brushes. But:

If you use Mirror Editing even particles with hidden keypoints may be moved, if their mirrored counterpart is moved.

To un-hide all hidden particles press Alt+H.

Select Modes



Path

No keypoints are visible, you can select/deselect only all particles.

Point

You see all of the keypoints.

Tip

You can see and edit (including the brushes) only the tip of the particles, i.e. the last keypoint.

Brush

With the buttons you can select the type of "Comb" utility you want to use. Below the brush types, their settings appear

Common Options:

Radius

Set the radius if the brush.

Strength

Set the strength of the brush effect (not for Add brush).

Add/Sub Grow/Shrink

Sets the brush to add the effect or reverse it..

None

No special tool, just edit the keypoints as “normal” vertices.

Comb

Moves the keypoints (similar to “proportional editing”).

Smooth

Parallels visually adjacent segments.

Add

Adds new particles.

Count

The number of new particles per step.

Interpolate

Interpolate the shape of new hairs from existing ones.

Steps

Amount of brush steps

Keys

How many keys to make new particles with.

Length

Scales the segments, so it makes the hair longer(Grow) or shorter(Shrink).

Puff

Rotates the hair around it’s first keypoint (root). So it makes the hair stand up (Add) or lay down (Sub).

Puff Volume

Apply puff to unselected end-points, (helps maintain hair volume when puffing root)

Cut

Scales the segments until the last keypoint reaches the brush.

Weight

This is especially useful for softbody animations, because the weight defines the softbody Goal. A keypoint with a weight of 1 won’t move at all, a keypoint with a weight of 0 subjects fully to softbody animation. This value is scaled by the GMin-GMax range of softbody goals.

Options

Deflect Emitter,Dist

Don’t move keypoints through the emitting mesh. Dist is the distance to keep from the Emitter.

Keep

Length

Keep the length of the segments between the keypoints when combing or smoothing the hair. This is done by moving all the other keypoints.

Root

Keep first key unmodified, so you can’t transplant hair.

X Mirror

Enable mirror editing across the local x axis.

Draw

Path Steps

Drawing steps, sets the smoothness of the drawn path.

Show Children

Draws the children of the particles too. This allows to fine tune the particles and see their effects on the result, but it may slow down your system if you have many children.

Soft Bodies



☐ Image 1a: A softbody cloth uncovering a text. [Animation](#) – [Blend file](#)

A Soft Body in general, is a simulation of a soft or rigid deformable object. In Blender, this system is best for simple cloth objects and closed meshes. There is dedicated [Cloth Simulation](#) physics that use a different solver, and is better for cloth.

This simulation is done by applying forces to the vertices or controlpoints of the object. There are exterior forces like gravity or forcefields and interior forces that hold the vertices together. This way you can simulate the shapes that an object would take on in reality if it had volume, was filled with something, and was acted on by real forces.

Soft Bodies can interact with other objects (*Collision*). They can interact with themselves (*Self Collision*).

The result of the Soft Body simulation can be converted to a static object. You can also *bake edit* the simulation, i.e. edit intermediate results and run the simulation from there.

Typical scenarios for using Soft Bodies



☐ Image 1b: A wind cone. The cone is a Soft Body, as the suspension. [Animation](#) – [Blend file](#)

Soft Bodies are well suited for:

- Elastic objects with or without collision.
- Flags, fabric reacting to forces.
- Certain modeling tasks, like a cushion or a table cloth over an object.
- Blender has another simulation system for clothing (see [Clothes](#)). But you can sometimes use Soft Bodies for certain parts of clothing, like wide sleeves.
- Hair (as long as you minimize collision).
- Animation of swinging ropes, chains and the like.

The following videos may give you some more ideas: [\[1\]](#), [\[2\]](#)

Creating a Soft Body

Soft Body simulation works for all objects that have vertices or control points:

- Meshes.
- Curves.

- Surfaces.
- Lattices.

To activate the Soft Body simulation for an object:

- In the Properties window, go to the Physics tab (it is all the way on the right, and looks like a bouncing ball).
- Activate the Soft Body button.

A lot of options appear. For a reference of all the settings see [this page](#).

- You start a Soft Body simulation with AltA.
- You pause the simulation with Space, continue with AltA.
- You stop the simulation with Esc.

Simulation Quality

The settings in the Soft Body Solver panel determine the accuracy of the simulation.

Min Step

Minimum simulation steps per frame. Increase this value, if the Soft Body misses fast moving collision objects.

Max Step

Maximum simulation steps per frame. Normally the number of simulation steps is set dynamically (with the Error Limit) but you have probably a good reason to change it.

Auto-Step

Use Velocities for automatic step sizes.

Error Limit

Rules the overall quality of the solution delivered. Default 0.1. The most critical setting that says how precise the solver should check for collisions. Start with a value that is 1/2 the average edge length. If there are visible errors, jitter, or over-exaggerated responses, decrease the value. The solver keeps track of how “bad” it is doing and the Error Limit causes the solver to do some “adaptive step sizing”.

Fuzzy

Simulation is faster, but less accurate.

Choke

Calms down (reduces the exit velocity of) a vertex or edge once it penetrates a collision mesh.

Diagnostics

Print Performance to Console

Prints on the console how the solver is doing.

Estimate Matrix

Estimate matrix. Split to COM , ROT ,SCALE

Cache and Bake

Soft Bodies and other physic simulations use a unified system for caching and baking. See [Particle Cache](#) for reference.

The results of the simulation are automatically cached to disk when the animation is played, so that the next time it runs, it can play again quickly by reading in the results from the disk. If you Bake the simulation the cache is protected and you will be asked when you're trying to change a setting that will make a recalculating necessary.



Beware of the Start and End settings

The simulation is only calculated for the frames in-between the Start and End frames (Bake panel), even if you don't actually bake the simulation! So if you want a simulation longer than the default setting of 250 frames you have to change the End frame.

- Caching:
 - As animation is played, each physics system writes each frame to disk, between the simulation start and end frames. These files are stored in folders with prefix “blendcache”, next to the .blend file.
 - The cache is cleared automatically on changes - but not on all changes, so it may be necessary to free it manually, e.g. if you change a force field. Note that for the cache to fill up, one has to start playback before or on the frame that the

simulation starts.

- If you are not allowed to write to the required sub-directory caching will not take place.
- The cache can be freed per physics system with a button in the panels, or with the CtrlB shortcut key to free it for all selected objects.
- You may run into trouble if your .blend file path is very long and your operating system has a limit on the path length that is supported.
- Baking:
 - The system is protected against changes after baking.
 - The Bake result is cleared also with CtrlB for all selected objects or click on Free Bake for the current Soft Body system.
 - If the mesh changes the simulation is not calculated anew.

For renderfarms, it is best to bake all the physics systems, and then copy the blendcache to the renderfarm as well.

Interaction in real time

To work with a Soft Body simulation you will find it handy to use the Timeline window. You can change between frames and the simulation will always be shown in the actual state. The option Continue Physics in the Playback menu of the Timeline window lets you interact in real time with the simulation, e.g. by moving collision objects or shake a Soft Body object. And this is real fun!



Continue Physics does not work while playing the animation with AltA

Right. This works only if you start the animation with the Play button of the Timeline window.

You can then select the Soft Body object while running the simulation and Apply the modifier in the Modifiers panel of the Editing context. This makes the deformation permanent.

Tips

- Soft Bodies work especially well if the objects have an even vertex distribution. You need enough vertices for good collisions. You change the deformation (the stiffness) if you add more vertices in a certain region (see the animation of *Image 1b*).
- The calculation of collisions may take a long time. If something is not visible, why calculate it?
- To speed up the collision calculation it is often useful to collide with an additional, simpler, invisible, somewhat larger object (see the example to *Image 1a*).
- Use Soft Bodies only where it makes sense. If you try to cover a body mesh with a tight piece of cloth and animate solely with Soft Body, you will have no success. Self collision of Soft Body hair may be activated, but that is a path that you have to wander alone. We will deal with [Collisions](#) in detail later.
- Try and use a Lattice or a Curve Guide Soft Body instead of the object itself. This may be magnitudes faster.

Links

- [Developer Notes](#)
- [Swinging of a chain](#)
- [Softbodies for Rigged Characters](#)

Exterior Forces

Exterior forces are applied to the vertices (and nearly exclusively to the vertices) of Soft Body objects. This is done using Newtons Laws of Physics:

1. If there is no force on a vertex, it stays either unmoved or moves with constant speed in a straight line.
2. The acceleration of a vertex depends on its mass and the force. The heavier the mass of a vertex the slower the acceleration. The larger the force the greater the acceleration.
3. For every action there is an equal and opposite reaction.

Well, this is done only in the range of computing accurateness, there is always a little damping to avoid overshoot of the calculation.

Example

We will begin with a very simple example - the default cube.

- To judge the effect of the external forces you should at first turn off the Goal, so that the vertices are not retracted to their original position.
- Press AltA.

What happens? The cube moves in negative Z-direction. Each of it's eight vertices is affected by a global, constant force - the gravitation. Gravitation without friction is independent from the weight of an object, so each object you would use as a Soft Body here would fall with the same acceleration. The object does not deform, because every vertex moves with the same speed in the same direction.

Settings

Soft Body Panel

Friction

The friction of the surrounding medium. The larger the friction, the more viscous is the medium. Friction always appears when a vertex moves relative to it's surround medium.

Mass

Mass value for vertices. Larger mass slows down acceleration, except for gravity where the motion is constant regardless of mass. Larger mass means larger inertia, so also braking a Soft Body is more difficult.

Mass Vertex Group

You can paint weight values for an mesh's mass, and select that vertex group here.

Speed

You can control the internal timing of the Softbody system with this value. It sets the correlation between frame rate and tempo of the simulation. A free falling body should cover a distance of about five meters after one second. You can adjust the scale of your scene and your simulation with this correlation. If you render with 25 frames per second and 1 meter shall be 1 BU, you have to set Speed to 1.3.

Force Fields

To create other forces you have to use another object, often Empty objects are used for that. You can use some of the forces on Soft Body vertices as on Particles. Soft Bodies react only to:

- Spherical
- Wind
- Vortex

Soft bodies do react on Harmonic fields, but not in a useful way. So if you use a Harmonic field for particles move the Soft body to another layer.

See the section [Force Fields](#) for details. The force fields are quite strong, a Spherical field with a strength of -1.0 has the same effect that gravity has - approximately - a force of 10 Newton.

Aerodynamics

This special exterior force is not applied to the vertices but to the connecting edges. Technically, a force perpendicular to the edge is applied. The force scales with the projection of the relative speed on the edge (dot product). Note that the force is the same if wind is blowing or if you drag the edge through the air with the same speed. That means that an edge moving in its own direction feels no force, and an edge moving perpendicular to its own direction feels maximum force.

Simple

Edges receive a drag force from surrounding media

Lift Force

Edges receive a lift force when passing through surrounding media.

Factor

How much aerodynamic force to use. Try a value of 30 at first.

Using a Goal

A goal is a shape that a soft body object tries to conform to.

You have to confine the movement of vertices in certain parts of the mesh, e.g. to attach a Soft Body object at other objects. This is done with the Vertex Group (target). The target position is the original position of the vertex, like it would result from the “normal” animation of an object including Shape Keys, Hooks and Armatures. The vertex tries to reach it’s target position with a certain, adjustable intensity.

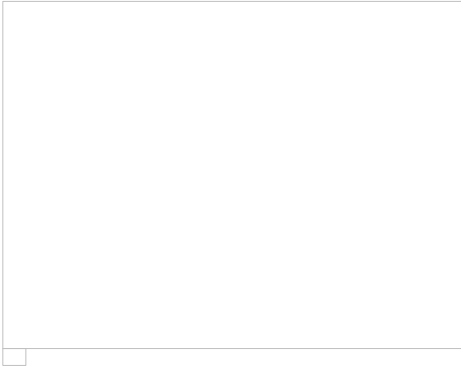


Image 2b: Shock absorber description.

Imagine the vertex is connected with it’s target through a spring (*Image 2b*).

Default

This parameter defines how strong the influence of this spring is. A strength of 1 means, that the vertex will not move as Soft Body at all, instead keep its original position. 0 Goal (or no Goal) means, that the vertex moves only according to Soft Body simulation. If no vertex group is used/assigned, this numeric field is the default goal weight for all vertices. If a vertex group is present and assigned, this button instead shows an popup selector button that allows you to choose the name of the goal vertex group. If you use a vertex group the weight of a vertex defines its goal.

Often [weight painting](#) is used to adjust the weight comfortably. For non-mesh objects the Weight parameter of their vertices/controlpoints is used instead (W in Edit mode, or use the Transform Properties panel). The weight of Hair particles can also be painted in [Particle Mode](#).

Minimum/Maximum

When you paint the values in vertex-groups (using WeightPaint mode), you can use the G Min and G Max to fine-tune (clamp) the weight values. The lowest vertex-weight (blue) will become G Min, the highest value (red) becomes G Max (please note that the blue-red color scale may be altered by User Preferences).



For now all is applied to single vertices

For now we have discussed vertex movement independent of each other, similar to particles. Every object without Goal would collapse completely if a non uniform force is applied. Now we will move to the next step, the forces that keep the structure of the object and make the Soft Body to a real Body.

Stiffness

The spring stiffness for Goal. A low value creates very weak springs (more flexible “attachment” to the goal), a high value creates a strong spring (a stiffer “attachment” to the goal).

Damping

The friction of the spring. With a high value the movement will soon come to an end (little jiggle).

Interior Forces



Image 1a: Vertices and forces along their connection edges.

To create a connection between the vertices of a Soft Body object there have to be forces that hold the vertices together. These forces are effective along the edges in a mesh, the connections between the vertices. The forces act like a spring. (*Image 1a*) illustrates how a 3×3 grid of vertices (a mesh plane in Blender) are connected in a Soft Body simulation.

But two vertices could freely rotate if you don't create additional edges between them. Have you ever tried building a storage shelf out of 4 planks alone? Well - don't do it, it will not be stable. The logical method to keep a body from collapsing would be to create additional edges between the vertices. This works pretty well, but would change your mesh topology drastically.



Image 1b: Additional forces with Stiff Quads enabled.

Luckily, Blender allows us to define additional *virtual* connections. On one hand we can define virtual connections between the diagonal edges of a quad face (Stiff Quads, *Image 1b*), on the other hand we can define virtual connections between a vertex and any vertices connected to it's neighbours (Bending Stiffness). In other words, the amount of bend that is allowed between a vertex and any other vertex that is separated by two edge connections.

Edges Settings

The characteristics of edges are set with the Soft Body Edge properties.

Use Edges

Allow the edges in a Mesh Object to act like springs.

Pull

The spring stiffness for edges (how much the edges are allowed to stretch). A low value means very weak springs (a very elastic material), a high value is a strong spring (a stiffer material) that resists being pulled apart. 0.5 is latex, 0.9 is like a sweater, 0.999 is a highly-starched napkin or leather. The Soft Body simulation tends to get unstable if you use a value of 0.999, so you should lower this value a bit if that happens.

Push

How much the Softbody resist being scrunched together, like a compression spring. Low values for fabric, high values for inflated objects and stiff material.

Damp

The friction for edge springs. High values (max of 50) dampen the Push/Pull effect and calm down the cloth.

Plastic

Permanent deformation of the object after a collision. The vertices take a new position without applying the modifier.

Bending

This option creates virtual connections between a vertex and the vertices connected to it's neighbors. This includes diagonal edges. Damping also applies to these connections.

Length

The edges can shrink or been blown up. This value is given in percent, 0 disables this function. 100% means no change, the body keeps 100% of his size.

Stiff Quads

For quad faces, the diagonal edges are used as springs. This stops quad faces to collapse completely on collisions (what they would do otherwise).

Shear

Stiffness of the virtual springs created for quad faces.

Preventing Collapse

To show the effect of the different edge settings we will use two cubes (blue: only quads, red: only tris) and let them fall without any goal onto a plane (how to set up collision is shown on the page [Collisions](#)).



Image 3a: Frame 1 without Stiff Quads.



Image 3b: Frame 36.

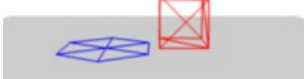


Image 3c: Frame 401.

In (*Image 3*), the default settings are used (without Stiff Quads). The “quad only” cube will collapse completely, the cube composed of tris keeps its shape, though it will deform temporarily because of the forces created during collision.



Image 4a: Frame 1 with Stiff Quads.



Image 4b: Frame 36.



Image 4c: Frame 401.

In (*Image 4*), Stiff Quads is activated (for both cubes). Both cubes keep their shape, there is no difference for the red cube, because it has no quads anyway.



Image 5a: Frame 1 with Bending Stiffness.



Image 5b: Frame 36.

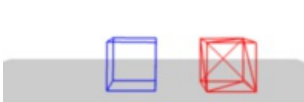


Image 5c: Frame 401.

[Blend file](#)

The second method to stop an object from collapsing is to change its Bending Stiffness. This includes the diagonal edges (Damping also applies to these connections).

In (*Image 5*), Be is activated with a strength setting of 1. Now both cubes are more rigid.

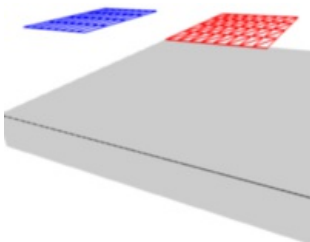


Image 6a: Two planes going to collide.

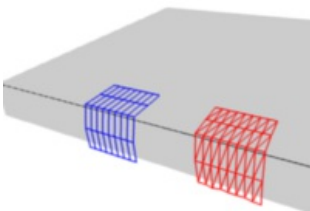


Image 6b: No bending stiffness, Frame 101.

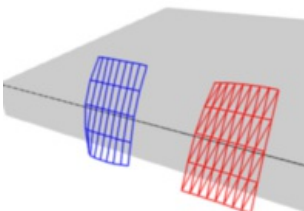


Image 6c: High bending stiffness (10), Frame 101.

Bending stiffness can also be used if you want to make a subdivided plane more plank like. Without Be the faces can freely rotate

against each other like hinges (*Image 6b*). There would be no change in the simulation if you activated Stiff Quads, because the faces are not deformed at all in this example.

Bending stiffness on the other hand prevents the plane from being - well - bent.

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Text partialy

Proposed fixes: none

Collisions

There are two different collision types that you may use: collision between different objects and internal collision. We should set one thing straight from the start: the primary targets of the collision calculation are the vertices of a Soft Body. So if you have too few vertices too few collision takes place. Secondly, you can use edges and faces to improve the collision calculation.

Collisions with other objects

For a *Soft Body* to collide with another object there are a few prerequisites:

1. Both objects have to share a layer, but the layer does not necessarily have to be visible.
2. The collision object has to be a mesh object.
3. You have to activate the option Collision in the Collision panel of the Physics sub-context (*Image 1*) for the collision object. The collision object may also be a Soft Body.
4. If you use modifiers such as Array and Mirror you have to activate EV.M.Stack to ensure that collision calculation is based on the modified object. The sequence of Modifiers is not important.

Examples

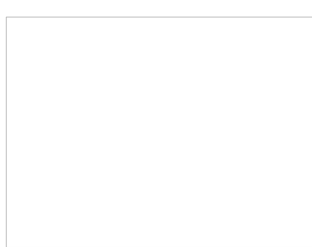


Image 2a: A Soft Body cube colliding with a plane.

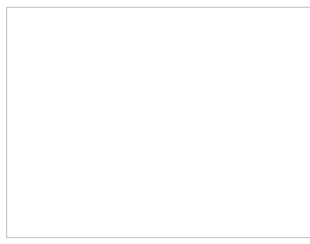


Image 2b: A Soft Body plane colliding with a cube - no interaction at all.

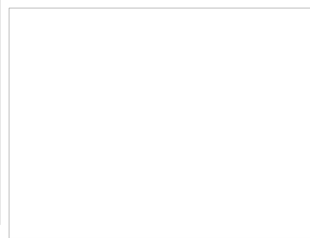


Image 2c: Collision with CFace activated.

A cube colliding with a plane works pretty well (*Image 2a*), but a plane falls right through a cube that it is supposed to collide with (*Image 2b*). Why is that? Because the default method of calculation only checks to see if the four vertices of the plane collides with the cube as the plane is pulled down by gravity. You can activate CFace to enable collision between the face of the plane and the object instead (*Image 2c*), but this type of calculation takes much longer.

Let's have a closer look at the collision calculation, so you can get an idea of how we might optimize it.

Calculating Collisions

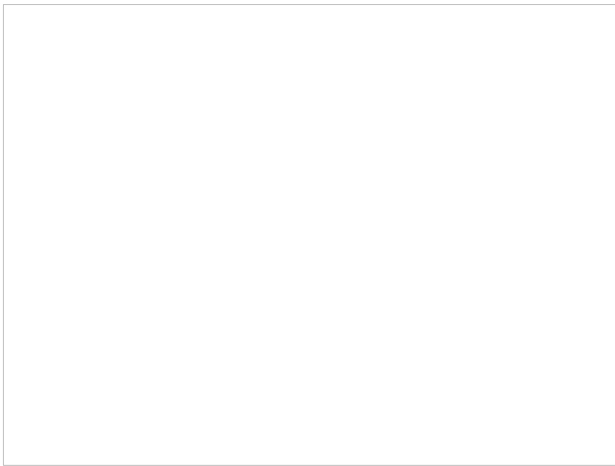


Image 3a: Visualization of the collision of a Soft Body vertex with a plane.

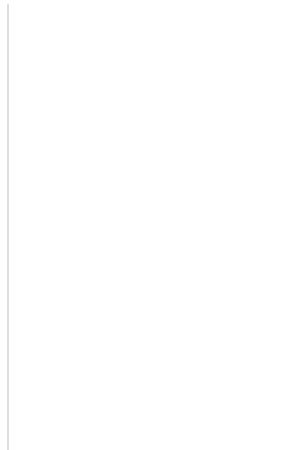


Image 3b: Six Soft Body vertices with different speed.
[Blend file](#)

Soft Body simulation is by default done on a per vertex basis. If the vertices of the Soft Body do not collide with the collision object there will be no interaction between the two objects.

In (*Image 3a*), you can see a vertex colliding with a plane. If a vertex penetrates the zone between Outer and Inner, it is repulsed by a force in the direction of the face normal. The position that a vertex finally ends up in is dependent on the forces that act upon it. In the example gravity and the repulsion force of the face balance out. The speed at which the vertex is pulled out of the collision zone is influenced by the Choke parameter (*Image 4*).

Now lets see what happens if we make vertices heavier and let them travel at a faster speed. In (*Image 3b*), you can see vertices traveling at different speeds. The two on the far right (5 and 6) are traveling so fast that they pass right through the collision zone (this is because of the default solver precision - which we can fix later). You will notice that the fourth vertex also travels quite fast and because it is heavier it breaches the inner zone. The first three vertices collide OK.



Image 3d: Also *Edges* and *Faces* can be used for the collision calculation.

You can set up your collision so that edges and even faces are included in the collision calculation (*Image 3d*). The collision is then calculated differently. It is checked whether the edge or face intersects with the collision object, the collision zones are not used.

Good collisions

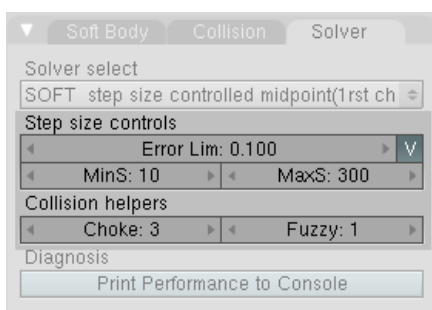


Image 4: Parameters for Soft Body calculation.

If the collision you have set up is not behaving properly, you can try the following:



The best way

Add Loop Cuts to your Soft Body object in strategic areas that you know are most likely to be involved in a collision.

- The Soft Body object must have more subdivisions than the collision object.
- Check the direction of the face normals.
- If the collision object has sharp spikes they might penetrate the Soft Body.
- The resolution of the solver must match the speed at which Soft Body vertices are traveling. Lower the parameter Error Lim and carefully increase Min S.
- Outer and Inner should be large enough, but zones of opposite faces should not overlap, or you have forces in opposite directions.
- If you use strong forces you should use large zones.
- Set Choke to a high enough value (all the way up if necessary) if you have difficulties with repelled vertices.
- Colliding faces are difficult to control and need long calculation times. Try not to use them.

Often it is better to create a simplified mesh to use as your collision object, however this may be difficult if you are using an animated mesh.

Self Collision

Self Collision is working only if you have activated Use Edges.

When enabled, allows you to control how Blender will prevent the Soft Body from intersecting with itself. Every vertex is surrounded with an elastic virtual ball. Vertices may not penetrate the balls of other vertices. If you want a good result you may have to adjust the size of these balls. Normally it works pretty well with the default options.

Ball Size Calculation

Man ("manual")

The Ball Size directly sets the ball size (in BU).

Av ("average")

The average length of all edges attached to the vertex is calculated and then multiplied with the Ball Size setting. Works well with evenly distributed vertices.

Min/Max

The ball size is as large as the smallest/largest spring length of the vertex multiplied with the Ball Size.

AvMiMax ("average min/max")

Size = $((\text{Min} + \text{Max})/2) \times \text{Ball Size}$.

Ball Size

Default 0.49 BU or fraction of the length of attached edges. The edge length is computed based on the algorithm you choose. You know how when someone stands too close to you, and feel uncomfortable? We call that our "personal space", and this setting is the factor that is multiplied by the spring length. It is a spherical distance (radius) within which, if another vertex of the same mesh enters, the vertex starts to deflect in order to avoid a self-collision.

Set this value to the fractional distance between vertices that you want them to have their own "space". Too high of a value will include too many vertices all the time and slow down the calculation. Too low of a level will let other vertices get too close and thus possibly intersect because there won't be enough time to slow them down.

Stiffness

Default 1.0. How elastic that ball of personal space is.

Damping

Default 0.5. How the vertex reacts. A low value just slows down the vertex as it gets too close. A high value repulses it.

Collisions with other objects are set in the (other) [Collision panel](#). To collide with another object they have to share at least one common layer.

Simple examples

some simple examples showing the power of softbody physics.

bouncing cube

change your start and end frames to 1 and 150.

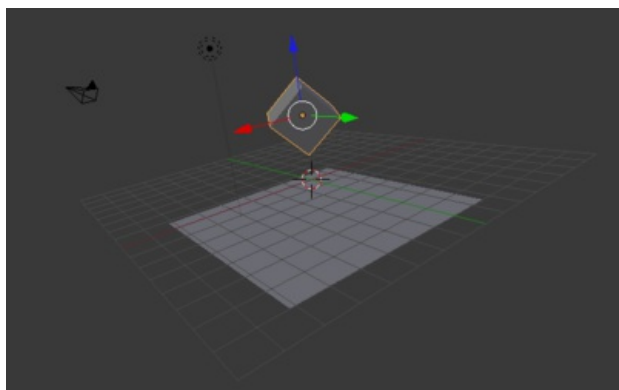


The timeline

add a plane, and scale it 5 times. next go to the physics tab, and add a collision. the default settings are fine for this example.

now add a cube, or use the default cube. Tab into edit mode and subdivide it thrice. then add a bevel modifier to it, to smoothen the edges. to add a little more, press r twice, and move your cursor a bit.

when finisht, your scene should look like this:



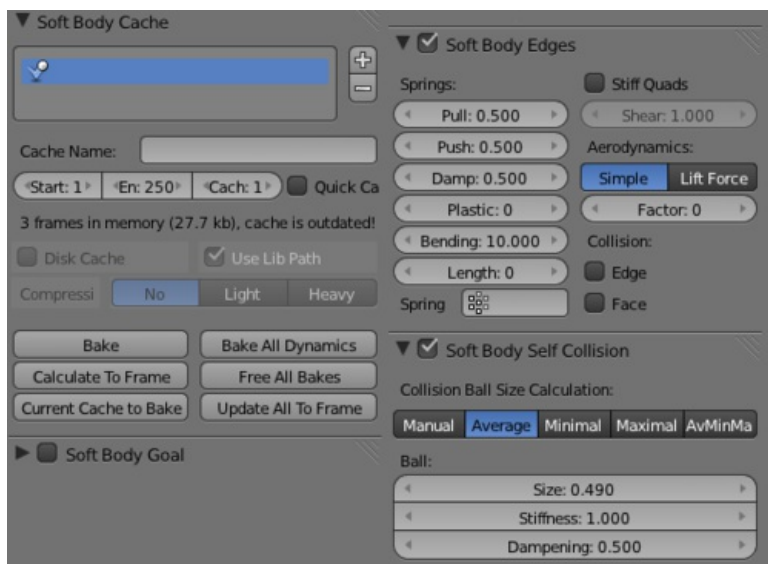
The scene, ready for softbody physics

Everything is ready to add the softbody physics. go to the physics tab and add 'softbody'. uncheck the soft body goal , and check softbody self collision. under soft body edges, increase the bending to 10.

playing tha animation with alt a will now give a slow animation of a bouncing cube. to speed things up, we need to bake the softbody physics.

Under Soft Body Cache change start and end to your start and end frames. in this case 1 and 150. to test if everything is working, you can take a cache step of 5 or 10, but for the final animation it's better to reduce it to 1, to cache everything.

when finisht, your physics panel should look like this:



The physics settings.

you can now bake the simulation, give the cube materials and textures and render the animation.

result

the rendered bouncing cube:

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- [2.49 Python API \(external link\)](#)
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Copy This page is a copy of the same page in 2.4 manual, need to be updated

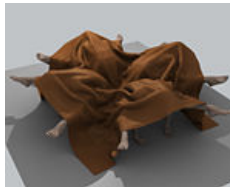
Text Partially

Proposed fixes: none

Cloth Simulation



☐ Cloth example.



☐ Cloth on carved wooden men (made by motorsep).



☐ Cloth example.

Cloth simulation is one of the hardest aspects of CG, because it is a deceptively simple real-world item that is taken for granted, yet actually has very complex internal and environmental interactions. After years of development, Blender has a very robust cloth simulator that is used to make clothing, flags, banners, and so on. Cloth interacts with and is affected by other moving objects, the wind and other forces, as well as a general aerodynamic model, all of which is under your control.

Description

A piece of cloth is any mesh, open or enclosed, that has been designated as cloth. The Cloth panels are located in the Physics sub-context and consist of three panels of options. Cloth is either an open or closed mesh and is mass-less, in that all cloth is assumed to have the same density, or mass per square unit.

Cloth is commonly modeled as a mesh grid primitive, or a cube, but can also be, for example, a teddy bear. However, Blender's [Softbody system](#) provides better simulation of closed meshes; Cloth is a specialized simulation of fabrics.

Once the object is designated as Cloth, a Cloth [modifier](#) will be added to the object's modifier stack automatically. As a [modifier](#) then, it can interact with other modifiers, such as Armature and Smooth. In these cases, the ultimate shape of the mesh is computed in accordance with the order of the modifier stack. For example, you should smooth the cloth *after* the modifier computes the shape of the cloth.

So you edit the Cloth in two places. In the F7 Physics buttons to edit the properties of the cloth and in the Modifier stack where you edit the Modifier properties related to display and interaction with other modifiers.

You can Apply the cloth modifier to freeze, or lock in, the shape of the mesh at that frame, which removes the modifier. For example, you can drape a flat cloth over a table, let the simulation run, and then apply the modifier. In this sense, you are using the simulator to save yourself a lot of modeling time.

Results of the simulation are saved in a cache, so that the shape of the mesh, once calculated for a frame in an animation, does not have to be recomputed again. If changes to the simulation are made, the user has full control over clearing the cache and re-running the simulation. Running the simulation for the first time is fully automatic and no baking or separate step interrupts the workflow.

Computation of the shape of the cloth at every frame is automatic and done in the background; thus you can continue working while the simulation is computed. However it is CPU-intensive and depending on the power of your PC and the complexity of the simulation, the amount of CPU needed to compute the mesh varies as does the lag you might notice.

Don't jump ahead

If you set up a cloth simulation but Blender has not computed the shapes for the duration of the simulation, and if you jump ahead a lot of frames forward in your animation, the cloth simulator may not be able to compute or show you an accurate mesh shape for that frame, if it has not previously computed the shape for the previous frame(s).

Workflow

A general process for working with cloth is to:

1. Model the cloth object as a general starting shape.

2. Designate the object as a "cloth" in the Physics tab of the Properties window.
3. Model other deflection objects that will interact with the cloth. Ensure the Deflection modifier is last on the modifier stack, after any other mesh deforming modifiers.
4. Light the cloth and assign materials and textures, UV-unwrapping if desired.
5. If desired, give the object particles, such as steam coming off the surface.
6. Run the simulation and adjust Options to obtain satisfactory results. The timeline window's VCR controls are great for this step.
7. Optionally age the mesh to some point in the simulation to obtain a new default starting shape.
8. Make minor edits to the mesh on a frame-by-frame basis to correct minor tears.

Creating Cloth Simulations

This section discusses how to use those options to get the effect you want. First, enable Cloth. Set up for the kind of cloth you are simulating. You can choose one of the presets to have a starting point.

As you can see, the heavier the fabric, the more stiff it is and the less it stretches and is affected by the air.

Cloth Panel

Presets

Contains a number of preset cloth examples, and allows you to add your own.

Quality

Set the number of simulation steps per frame. Higher values result in better quality, but is slower.

Material

Mass

The mass of the cloth material.

Structural

Overall stiffness of the cloth.

Bending

Wrinkle coefficient. Higher creates more large folds.

Damping

Spring

Damping of cloth velocity. Higher = more smooth, less jiggling.

Air

Air has normally some thickness which slows falling things down.

Pinning



Cloth in action.

The first thing you need when pinning cloth are [Vertex Groups](#). There are several ways of doing this including using the Weight Paint tool to paint the areas you want to pin (see the [Weight paint](#) section of the manual).

Once you have a vertex group set, things are pretty straightforward, all you have to do is press the Pinning of cloth button in the Cloth panel and select which vertex group you want to use, and the stiffness you want it at.

Stiffness

Target position stiffness. You can leave the stiffness as it is, default value of 1 is fine.

Collisions

In most cases, a piece of cloth does not just hang there in 3D space, it collides with other objects in the environment. To ensure proper simulation, there are several items that have to be set up and working together:

1. The Cloth object must be told to participate in Collisions.
2. Optionally (but recommended) tell the cloth to collide with itself.
3. Other objects must be visible to the Cloth object *via* shared layers.
4. The other objects must be mesh objects.
5. The other objects may move or be themselves deformed by other objects (like an armature or shape key).
6. The other mesh objects must be told to deflect the cloth object.
7. The blend file must be saved in a directory so that simulation results can be saved.
8. You then Bake the simulation. The simulator computes the shape of the cloth for a frame range.
9. You can then edit the simulation results, or make adjustments to the cloth mesh, at specific frames.
10. You can make adjustments to the environment or deforming objects, and then re-run the cloth simulation from the current frame forward.

Collision Settings



Cloth Collisions panel.

Now you must tell the Cloth object that you want it to participate in collisions. For the cloth object, locate the Cloth Collision panel, shown to the right:

Enable Collisions

LMB  click this to tell the cloth object that it needs to move out of the way.

Quality

A general setting for how fine and good a simulation you wish. Higher numbers take more time but ensure less tears and penetrations through the cloth.

Distance

As another object gets this close to it (in Blender Units), the simulation will start to push the cloth out of the way.

Repel

Repulsion force to apply when cloth is close to colliding.

Repel Distance

Maximum distance to apply repulsion force. Must be greater than minimum distance.

Friction

A coefficient for how slippery the cloth is when it collides with the mesh object. For example, silk has a lower coefficient of friction than cotton.

Self-collisions

Real cloth cannot permeate itself, so you normally want the cloth to self-collide.

Enable Self Collisions

Click this to tell the cloth object that it should not penetrate itself. This adds to simulation compute time, but provides more realistic results. A flag, viewed from a distance does not need this enabled, but a close-up of a cape or blouse on a character should have this enabled.

Quality

For higher self-collision quality just increase the Quality and more self collision layers can be solved. Just keep in mind that you need to have at least the same Collision Quality value as the Quality value.





Distance

If you encounter problems, you could also change the Min Distance value for the self-collisions. The best value is 0.75, for fast things you better take 1.0. The value 0.5 is quite risky (most likely many penetrations) but also gives some speedup.

Regression blend file: [Cloth selfcollisions](#).

Shared Layers

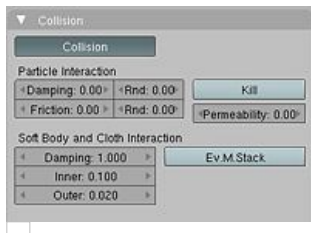
Suppose you have two objects: a pair of Pants on layers 2 and 3, and your Character mesh on layers 1 and 2. You have enabled the Pants as cloth as described above. You must now make the Character “visible” to the Cloth object, so that as your character bends its leg, it will push the cloth. This principle is the same for all simulations; simulations only interact with objects on a shared layer. In this example, both objects share layer 2.

To view/change an object’s layers, RMB  click to select the object in Object mode in the 3D view. M to bring up the “Move Layers” popup, which shows you all the layers that the object is on. To put the object on a single layer, LMB  click the layer button. To put the object on multiple layers, ⇧ Shift LMB  the layer buttons. To remove an object from a selected layer, simply ⇧ Shift LMB  the layer button again to toggle it.

Mesh Objects Collide

If your colliding object is not a mesh object, such as a NURBS surface, or text object, you must convert it to a mesh object. To do so, select the object in object mode, and in the 3D View header, select Object → Convert Object Type (AltC), and select Mesh from the popup menu.

Cloth - Object collisions



Collision settings.

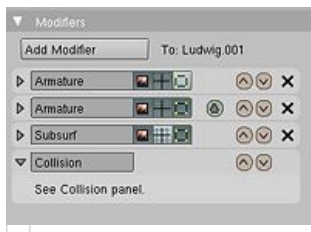
The cloth object needs to be deflected by some other object. To deflect a cloth, the object must be enabled as an object that collides with the cloth object. To enable Cloth - Object collisions, you have to enable deflections on the collision object (not on the cloth object).

In the Buttons window, Object context, Physics sub-context, locate the Collision panel shown to the right. It is also important to note that this collision panel is used to tell all simulations that this object is to participate in colliding/deflecting other objects on a shared layer (particles, soft bodies, and cloth).

Beware

There are three different Collision panels, all found in the Physics sub-context. The first (by default), a tab beside the Fields panel, is the one needed here. The second panel, a tab in the Soft Body group, concern softbodies (and so has nothing to see with clothes). And we have already seen the last one, by default a tab beside the Cloth panel.

Mesh Object Modifier Stack



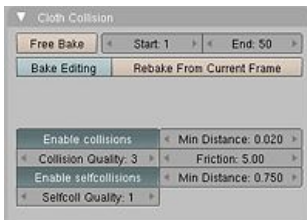
Collision stack.

The object’s shape deforms the cloth, so the cloth simulation must know the “true” shape of that mesh object at that frame. This true shape is the basis shape as modified by shape keys or armatures. Therefore, the Collision modifier must be **after** any of those. The image to the right shows the Modifiers panel for the Character mesh object (not the cloth object).

Cloth Cache

Cache settings for cloth are the same as with other dynamic systems. See [Particle Cache](#) for details.

Bake Collision



After you have set up the deflection mesh for the frame range you intend to run the simulation (including animating that mesh *via* armatures), you can now tell the cloth simulation to compute (and avoid) collisions. Select the cloth object and in the Object context, Physics sub-context, set the Start and End settings for the simulation frames you wish to compute, and click the Bake button.

You cannot change Start or End without clearing the bake simulation. When the simulation has finished, you will notice you have the option to free the bake, edit the bake and re-bake:

There's a few things you'll probably notice right away. First, it will bake significantly slower than before, and it will probably clip through the box pretty bad as in the picture on the right.

Editing the cached simulation=

The cache contains the shape of the mesh at each frame. You can edit the cached simulation, when you baked the simulation and pressed the Bake Editing button. Just go to the frame you want to fix and ⇐ Tab into Edit mode. There you can move your vertices using all of Blender's mesh shaping tools. When you exit, the shape of the mesh will be recorded for that frame of the animation. If you want Blender to resume the simulation using the new shape forward, LMB click 'Rebake from next Frame' and play the animation. Blender will then pick up with that shape and resume the simulation.

Edit the mesh to correct minor tears and places where the colliding object has punctured the cloth.

If you add, delete, extrude, or remove the vertices in the mesh, Blender will take the new mesh as the starting shape of the mesh back to the *first frame* of the animation, replacing the original shape you started with, up to the frame you were on when you edited the mesh. Therefore, if you change the content of a mesh, when you ⇐ Tab out of Edit mode, you should unprotect and clear the cache so that Blender will make a consistent simulation.

Troubleshooting

If you encounter some problems with collision detection there are two ways to fix them:

- The fastest solution would be to put up the Min Distance setting under the Cloth Collision panel. This will be the fastest way to fix the clipping, however, it will be less accurate and won't look as good. Using this method tends to make it look like the cloth is resting on air, and gives it a very rounded look.
- A second method is to increase the Quality (in the first Cloth panel). This results in smaller steps for the simulator and therefore to a higher probability that fast moving collisions get catch. You can also increase the Collision Quality to perform more iterations to get collisions solved.
- If none of the methods help, you can easily edit the cached/baked result in Edit mode afterwards.
- My Cloth is torn by the deforming mesh - he "Hulks Out": Increase its structural stiffness (StructStiff setting, Cloth panel) very high, like 1000.

Subsurf modifier

A bake/cache is done for every subsurf level so please use **one equal** subsurf level for render and preview.

Examples

To start with cloth, the first thing you need, of course, is some fabric. So, let's delete the default cube and add a plane. I scaled mine up along the Y axis, but you don't have to do this. In order to get some good floppy and flexible fabric, you'll need to subdivide it several times. I did it 8 times for this example. So ⇐ Tab into Edit mode, and press W → Subdivide multi, and set it to 8.

Now, we'll make this cloth by going to the Object context (F7) → Physics sub-context. Scroll down until you see the Cloth panel, and press the Cloth button. Now, a lot of settings will appear, most of which we'll ignore now.

That's all you need to do to set your cloth up for animating, but if you hit AltA, your lovely fabric will just drop very un-spectacularly. That's what we'll cover in the next two sections about pinning and colliding.

Using Simulation to Shape/Sculpt a Mesh

You can Apply the Cloth modifier at any point to freeze the mesh in position at that frame. You can then re-enable cloth, setting the start and end frames from which to run the simulation forward.

Another example of aging is a flag. Define the flag as a simple grid shape and pin the edge against the flagpole. Simulate for 50 frames or so, and the flag will drop to its "rest" position. Apply the Cloth modifier. If you want the flag to flap or otherwise move in the scene, re-enable it for the frame range when it is in camera view.

Smoothing of Cloth

Now, if you followed this from the previous section, your cloth is probably looking a little blocky. In order to make it look nice and smooth like the picture you need to apply a Smooth and/or Subsurf modifier in the Modifiers panel under the Editing context (F9). Then, in the same context, find the Links and Materials panel (the same one you used for vertex groups) and press Set Smooth.

Now, if you hit AltA, things are starting to look pretty nice, don't you think?

Cloth on armature

Cloth deformed by armature and also respecting an additional collision object: [Regression blend file](#).

Cloth with animated vertex groups

Cloth with animated pinned vertices: [Regression blend file](#). UNSUPPORTED: Starting with a goal of 0 and increasing it, but still having the vertex not pinned will not work (e.g. from goal = 0 to goal = 0.5).

Cloth with Dynamic Paint

Cloth with Dynamic Paint using animated vertex groups: [Regression blend file](#). UNSUPPORTED: Starting with a goal of 0 and increasing it, but still having the vertex not pinned will not work (e.g. from goal = 0 to goal = 0.5) because the necessary "goal springs" cannot be generated on the fly.

Using Cloth for Softbodies



☐ Using cloth for softbodies.

Cloth can also be used to simulate softbodies. It's for sure not it's main purpose but it works nonetheless. The example image uses standard Rubber material, no fancy settings, just AltA.

Blend file for the example image: [Using Cloth for softbodies](#).

Cloth with Wind



☐ Flag with wind applied.

Regression blend file for Cloth with wind and self collisions (also the blend for the image above): [Cloth flag with wind and selfcollisions](#).

Fluid Simulation

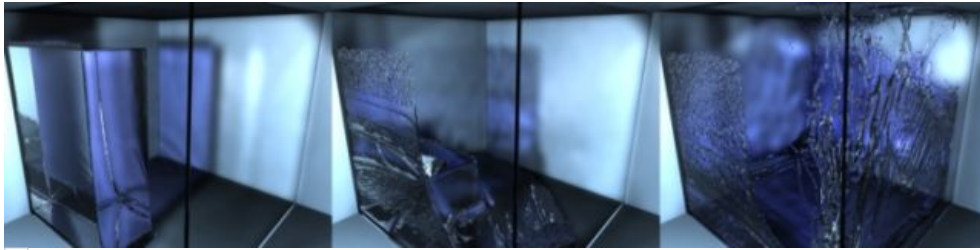
Mode: Object mode / Edit mode (Mesh)

Panel: Physics sub-context → Fluid

Description

While modeling a scene with blender, certain objects can be marked to participate in the fluid simulation, e.g. as fluid or as an obstacle. The bounding box of another object will be used to define a box-shaped region to simulate the fluid in (the so called “simulation domain”). The global simulation parameters (such as viscosity and gravity) can be set for this domain object.

Using the BAKE button, the geometry and settings are exported to the simulator and the fluid simulation is performed, generating a surface mesh together with a preview for each animation frame, and saving them to hard disk. Then the appropriate fluid surface for the current frame is loaded from disk and displayed or rendered.



A breaking dam.

Workflow

In general, you follow these steps:

- set the [simulation domain](#) (the portion of the scene where the fluid will flow),
- set the [fluid source\(s\)](#), and specify its material, viscosity, and initial velocity,
- eventually, set other [objects to control the volume](#) of the fluid (inlets and outlets),
- eventually, set other objects related to the fluid, like:
 - [obstacles](#),
 - [particles](#) floating on the fluid,
 - [fluid control](#), to shape part of the fluid in the desired form,
- eventually, [animate the fluid properties](#),
- [Bake the simulation](#) (eventually, revise as necessary and bake repeatedly).



Baking is done on the Domain object!

When you calculate the fluid simulation, **you bake the simulation on the domain object**.

For this reason:

- all the baking options are visible only when selecting the Domain Object,
- baking options are explained in the [the baking section](#) of the Domain manual page.

More about the simulation

To know more about simulating fluids in Blender you can read:

- some [useful hint](#) about the simulation,
- some [technical details](#), to learn how to do a more realistic fluid simulation,
- the [fluids appendix](#) to learn limitations and workarounds, and some additional links.

Page status ([reviewing guidelines](#))

Text todo: review the viscosity table commented text

Proposed fixes: none

Fluid Domain

The Domain Object

The bounding box of the object serves as the boundary of the simulation. **All fluid objects must be in the domain.** Fluid objects outside the domain will not bake. No tiny droplets can move outside this domain; it's as if the fluid is contained within the 3D space by invisible force fields. There can be only a single fluid simulation domain object in the scene.

The shape of the object does not matter because it will *always* be treated like box (The lengths of the bounding box sides can be different). So, usually there won't be any reason to use another shape than a box. If you need obstacles or other boundaries than a box to interfere with the fluid flow, you need to insert additional obstacle objects *inside* the domain boundary.

This object will be *replaced* by the fluid during the simulation.

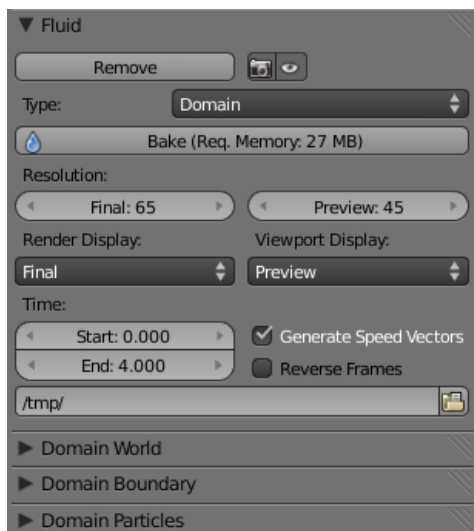


Baking is done on the Domain object

When you calculate the fluid simulation, **you bake the simulation on the domain object.** For this reason all the baking options are visible only when selecting the Domain Object.

For baking options, please refer to [the baking section](#) in this page.

Options



The fluid simulation options with Domain selected

Bake button

For baking options please refer to [the baking section](#) in this page.

Resolution

Render resolution

The granularity at which the actual fluid simulation is performed. This is probably the most important setting for the simulation as it determines the amount of details in the fluid, the memory and disk usage as well as computational time.



10cm mug at Resolution 70.



10cm mug at Resolution 200.

Note that the amount of required memory quickly increases: a resolution of 32 requires ca. 4MB, 64 requires ca. 30MB, while 128 already needs more than 230MB. Make sure to set the resolution low enough, depending on how much memory you have, to prevent Blender from crashing or freezing. Remember also that many operating systems limit the amount of memory that can be allocated by a single *process*, such as Blender, even if the *machine* contains much more than this. Find out what limitations apply to your machine.

Resolution and Real-size of the Domain

Be sure to set the resolution appropriate to the real-world size of the domain (see the *Realworld-size* in the [Domain Wold panel](#)). If the domain is not cubic, the resolution will be taken for the longest side. The resolutions along the other sides will be reduced according to their lengths (therefore, a non-cubic domain will need less memory than a cubic one, resolutions being the same).

Previewresolution

This is the resolution at which the preview surface meshes will be generated. So it does not influence the actual simulation. Even if “there is nothing to see” in the preview, there might be a thin fluid surface that cannot be resolved in the preview.

Display quality

How to display a baked simulation in the 3d view (menu *Viewport Display*) and for rendering (menu *Render Display*):

- *Geometry*: use the original geometry (before simulation).
- *Preview*: use the preview mesh.
- *Final*: use the final high definition mesh.

When no baked data is found, the original mesh will be displayed by default.

After you have baked a domain, it is displayed (usually) in the Blender window as the preview mesh. To see the size and scope of the original domain box, select *Geometry* in the left dropdown.

Time

Start

It is the simulation start time (in seconds).

This option makes the simulation computation in Blender start later in the simulation. The domain deformations and fluid flow prior to the start time are not saved.

For example, if you wanted the fluid to appear to already have been flowing for 4 seconds before the actual first frame of data, you would enter 4.0 here.

End

It is the simulation ending time (in seconds).



Start and end times have nothing to do with how many frames are baked

If you set *Start* time to 3.0, and *End* time to 4.0, you will simulate 1 second of fluid motion. That one second of fluid motion will be spread across however-many frames are set in the Anim panel (Scene context → Render sub-context → Anim and Output panel). This means, for example, that if you have Blender set to make 250 frames at 25 fps, the fluid will look like it had already been flowing for 3 seconds at the start of the simulation, *but* will play in slow motion (one-tenth normal speed), since the 1 second fluid sim plays out over the course of 10 video seconds. To correct this, change the end time to 13.0 (3.0 + 10.0) to match the 250 frames at 25 fps. Now, the simulation will be real-time, since you set 10 seconds of fluid motion to simulate over 10 seconds of animation. Having these controls in effect gives you a “speed control” over the simulation.

Generate Speed Vector

If this button is clicked, no speed vectors will be exported. So by default, speed vectors are generated and stored on disk. They can be used to compute image based motion blur with the compositing nodes.

Reverse fluid frames

The simulation is calculated backward

Bake directory

For baking options please refer to [the baking section](#) in this page.

Domain World



The Domain World options.

Viscosity

The “thickness” of the fluid and actually the force needed to move an object of a certain surface area through it at a certain speed. You can either enter a value directly or use one of the presets in the drop down (such as honey, oil, or water). For manual entry, please note that the normal real-world viscosity (the so-called dynamic viscosity) is measured in Pascal-seconds (Pa.s), or in Poise units (P, equal to 0.1 Pa.s, pronounced “*pvæz*”, from the Frenchman Jean-Louis Poiseuille, who discovered the laws on “the laminar flow of viscous fluids”), and commonly centiPoise units (cP, equal to 0.001 Pa.s, “*sentipvæz*”). Blender, on the other hand, uses the kinematic viscosity (which is dynamic viscosity in Pa.s, divided by the density in kg.m^{-3} , unit $\text{m}^2.\text{s}^{-1}$). The table below gives some examples of fluids together with their dynamic and kinematic viscosities. Manual entries are specified by a floating point number and an exponent. These floating point and exponent entry fields (scientific notation) simplify entering very small or large numbers. The viscosity of water at room temperature is 1.002 cP, or 0.001002 Pa.s; the density of water is about 1000 kg.m^{-3} , which gives us a kinematic viscosity of $0.000001002 \text{ m}^2.\text{s}^{-1}$ - so the entry would be 1.002 times 10 to the minus six (1.002×10^{-6} in scientific notation). Hot Glass and melting iron is a fluid, but very thick; you should enter something like 1.0×10^0 (= 1.0) as its kinematic viscosity (indicating a value of 1.0×10^6 cP). Note that the simulator is not suitable for non-fluids, such as materials that do not “flow”. Simply setting the viscosity to very large values will not result in rigid body behavior, but might cause instabilities.

Viscosity varies

The default values in Blender are considered typical for those types of fluids and “look right” when animated. However, actual viscosity of some fluids, especially sugar-laden fluids like chocolate syrup and honey, depend highly on temperature and concentration. Oil viscosity varies by SAE rating. Glass at room temperature is basically a solid, but glass at 1500 degrees Celsius flows (nearly) like water.

Realworld-size

Blender Viscosity Unit Conversion

Fluid	dynamic viscosity (in cP)	kinematic viscosity (Blender, in $\text{m}^2.\text{s}^{-1}$)
Water (20°C)	1.002×10^0 (1.002)	1.002×10^{-6} (0.000001002)
Oil SAE 50	5.0×10^2 (500)	5.0×10^{-5} (0.00005)
Honey (20°C)	1.0×10^4 (10,000)	2.0×10^{-3} (0.002)
Chocolate Syrup	3.0×10^4 (30,000)	3.0×10^{-3} (0.003)
Ketchup	1.0×10^5 (100,000)	1.0×10^{-1} (0.1)
Melting Glass	1.0×10^{15}	1.0×10^0 (1.0)

If you want to create a mug of coffee, this might be 10 cm (0.1 meters), while a swimming pool might be 10m. The size set here is for the longest side of the domain bounding box.

Optimization

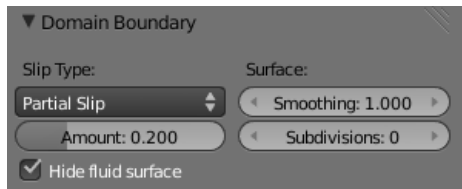
Gridlevel

How many adaptive grid levels to be used during simulation - setting this to -1 will perform automatic selection.

Compressibility

If you have problems with large standing fluid regions at high resolution, it might help to reduce this number (note that this will increase computation times).

Domain Boundary



The Domain Boundary panel

This box has all the slip and surface options.

Boundary type

Determines the stickiness of the obstacle surface, called “Surface Adhesion”. Surface Adhesion depends in real-world on the fluid and the graininess or friction/adhesion/absorption qualities of the surface:

No Slip

Causes the fluid to stick to the obstacle (zero velocity).

Free Slip

Allows movement along the obstacle (only zero normal velocity).

Part Slip

Mixes both types, with 0 being equal as *No Slip*, and 1 being identical to *Free Slip*.

Surface

Surface Smoothing

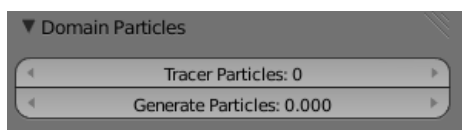
Amount of smoothing to be applied to the fluid surface. 1.0 is standard, 0 is off, while larger values increase the amount of smoothing.

Subdivisions

Allows the creation of high-res surface meshes directly during the simulation (as opposed to doing it afterwards like a subdivision modifier). A value of 1 means no subdivision, and each increase results in one further subdivision of each fluid voxel. The resulting meshes thus quickly become large, and can require large amounts of disk space. Be careful in combination with large smoothing values - this can lead to long computation times due to the surface mesh generation.

Hide fluid surface

Domain Particles



The Domain Particles panel

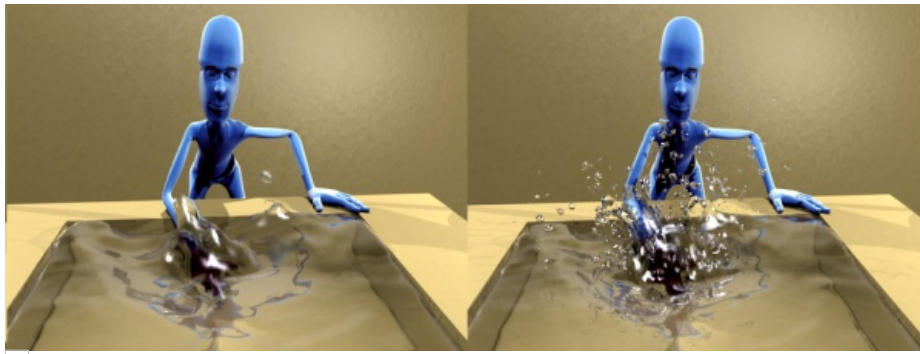
Here you can add particles to the fluid simulated, to enhance the visual effect.

Tracer Particles

Number of tracer particles to be put into the fluid at the beginning of the simulation. To display them create another object with the Particle fluid type, explained below, that uses the same bake directory as the domain.

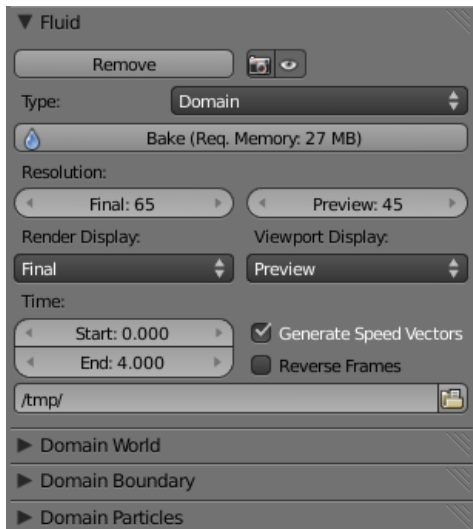
Generate Particles

Controls the amount of fluid particles to create (0=off, 1=normal, >1=more). To use it, you have to have a surface subdivision value of at least 2.



An example of the effect of particles can be seen here - the image to the left was simulated without, and the right one with particles and subdivision enabled.

Baking



The fluid simulation options with Domain selected

Bake Button

Perform the actual fluid simulation. Blender will continue to work normally, except there will be a status bar in the top of the window, next to the render pulldown. Pressing Esc or the "x" next to the status bar will abort the simulation. Afterwards two ".bobj.gz" (one for the Final quality, one for the Preview quality), plus one ".bvel.gz" (for the Final quality) will be in the selected output directory for each frame.

Bake directory

REQUIRED!

Directory and file prefix to store baked surface meshes.

This is similar to the animation output settings, only selecting a file is a bit special: when you select any of the previously generated surface meshes (e.g. "test1_fluidsurface_final_0132.bobj.gz"), the prefix will be automatically set ("test1_" in this example). This way the simulation can be done several times with different settings, and allows quick changes between the different sets of surface data.


The default value is "/tmp/", which is probably *not* what you want. Choose an appropriate directory-name and file prefix so that these files will be stored in an appropriate location *and* named in such a way that two different fluid-simulations won't conflict with one another (if you're intending to specify only a directory-name here, i.e. without a filename-prefix, don't forget the trailing "/").

Notes

Unique domain

Because of the possibility of spanning and linking between scenes, there can only be one domain in an entire .blend file.

Selecting a Baked Domain

After a domain has been baked, it changes to the fluid mesh. To re-select the domain so that you can bake it again after you have made changes, go to any frame and select (RMB ) the fluid mesh. Then you can click the BAKE button again to recompute the fluid flows inside that domain.

Baking always starts at Frame #1:

The fluid simulator disregards the Sta setting in the Anim panel, it will always bake from frame 1.

If you wish the simulation to start later than frame 1, you must key the fluid objects in your domain to be inactive until the frame you desire to start the simulation. See [below](#) for more information.

Baking always ends at the End Frame set in the Anim panel:

If your frame-rate is 25 frames per second, and ending time is 4.0 seconds, then you should (if your start time is 0) set your animation to end at frame $4.0 \times 25 = 100$.

Freeing the previous baked solutions

Deleting the content of the "Bake" directory is a destructive way to achieve this. Be careful if more than one simulation uses the same bake directory (be sure they use different filenames, or they will overwrite one another)!

Reusing Bakes

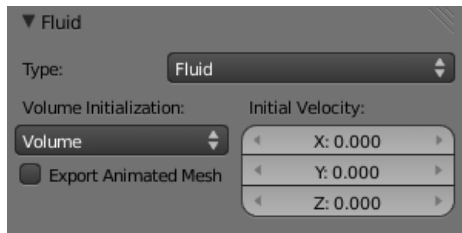
Manually entering (or searching for) a previously saved (baked) computational directory and filename mask will switch the fluid flow and mesh deformation to use that which existed during the old bake. Thus, you can re-use baked flows by simply pointing to them in this field.

Baking processing time

Baking takes a **lot** of compute power (hence time). Depending on the scene, it might be preferable to bake overnight.

If the mesh has modifiers, the rendering settings are used for exporting the mesh to the fluid solver. Depending on the setting, calculation times and memory use might exponentially increase. For example, when using a moving mesh with Subsurf as an obstacle, it might help to decrease simulation time by switching it off, or to a low subdivision level. When the setup/rig is correct, you can always increase settings to yield a more realistic result.

Fluid Object



Fluid object settings

All regions of this object that are inside the domain bounding box will be used as actual fluid in the simulation. If you place more than one fluid object inside the domain, they should currently not intersect. Also make sure the surface normals are pointing outwards. In contrast to domain objects, the actual mesh geometry is used for fluid objects.

Volume initialization type

- Volume will initialize the inner part of the object as fluid. This works only for closed objects.
- Shell will initialize only a thin layer for all faces of the mesh. This also works for non closed meshes.
- Both combines volume and shell - the mesh should also be closed. See the picture below.



Example of the different volume init types: Volume, Shell and Both (the shell is usually slightly larger than the inner volume)

Animated Mesh/Export

Click this button if the mesh is animated (e.g. deformed by an armature, shape keys or a lattice). Note that this can be significantly slower, and is not required if the mesh is animated with position or rotation lpos (i.e. only *object* transformations).

Initial velocity

Speed of the fluid at the beginning of the simulation, in meters per second.



The direction of Surface Normals makes a big difference!

Blender uses the orientation of the Surface Normals to determine what is “inside of” the Fluid object and what is “outside”. You want all of the normals to face *outside* (in Edit mode, use CtrlN or press Space and choose Edit → Normals → Calculate Outside). If the normals face the wrong way, you’ll be rewarded with a “gigantic flood of water” because Blender will think that the volume of the object is outside of its mesh! This applies regardless of the Volume init type setting.

Fluid Obstacle

This object will be used as an obstacle in the simulation. As with a fluid object, obstacle objects currently should not intersect. As for fluid objects, the actual mesh geometry is used for obstacles. For objects with a volume, make sure that the normals of the obstacle are calculated correctly, and radiating properly (use the Flip Normal button, in Edit mode, Mesh Tools panel, Editing context [F9]), particularly when using a spinned container. Applying the Modifier SubSurf before baking the simulation could also be a good idea if the mesh is not animated.

Volume initialization type

- Volume will initialize the inner part of the object as fluid. This works only for closed objects.
- Shell will initialize only a thin layer for all faces of the mesh. This also works for non closed meshes.
- Both combines volume and shell - the mesh should also be closed. See the picture below.



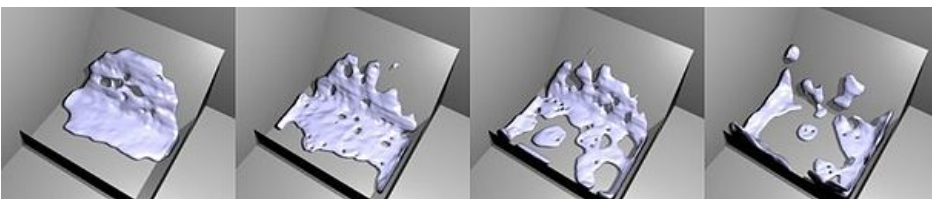
☐ Example of the different volume init types: Volume, Shell and Both (the shell is usually slightly larger than the inner volume)

Boundary type

Determines the stickiness of the obstacle surface, called "Surface Adhesion". Surface Adhesion depends in real-world on the fluid and the graininess or friction/adhesion/absorption qualities of the surface.

- Noslip causes the fluid to stick to the obstacle (zero velocity).
- Free(-slip) allows movement along the obstacle (only zero normal velocity).
- Part(-slip) mixes both types, with 0 being mostly noslip, and 1 being identical to freeslip.

Note that if the mesh is moving, it will be treated as noslip automatically.



☐ Example of the different boundary types for a drop falling onto the slanted wall. From left to right: no-slip, part-slip 0.3, part-slip 0.7 and free-slip.

Animated Mesh/Export

Click this button if the mesh is animated (e.g. deformed by an armature, shape keys or a lattice). Note that this can be significantly slower, and is not required if the mesh is animated with position or rotation lpos (i.e. only *object* transformations).

PartSlip Amount

Amount of mixing between no- and free-slip, described above.

Moving obstacles support

Blender supports now moving obstacles.

In the past, a moving obstacle was automatically treated as no slip (sticky), so if you wanted to splash off of a moving object, you had to put a transparent plane in the spot where the fluid will hit the moving object, exactly aligned and shaped as the object, to fake the splash. This is not needed anymore.

Impact Factor

Amount of fluid volume correction for gain/loss from impacting with moving objects. If this object is not moving, this setting has no effect. However, if it is and the fluid collides with it, a negative value takes volume away from the Domain, and a positive number adds to it. Ranges from -2.0 to 10.0.

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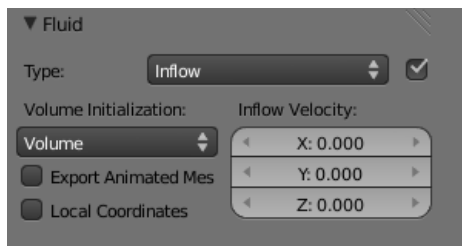
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Controlling the fluid volume

To control the volume of the fluid simulation, you can set objects in the scene to or add or absorb fluid within the [Fluid Domain](#).

Inflow

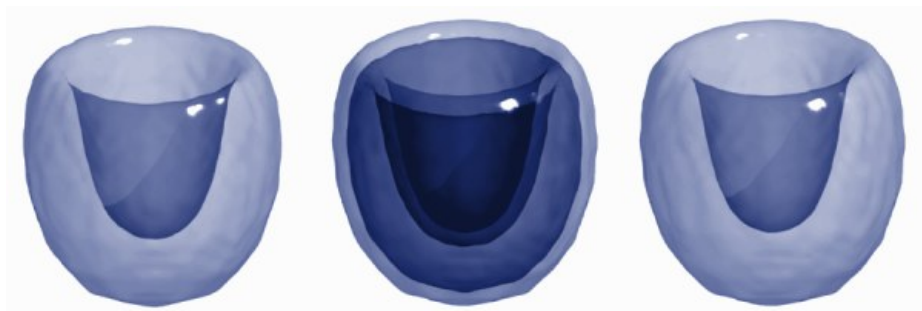


Fluid inflow settings

This object will put fluid into the simulation, like a water tap.

Volume initialization type

- Volume will initialize the inner part of the object as fluid. This works only for closed objects.
- Shell will initialize only a thin layer for all faces of the mesh. This also works for non closed meshes.
- Both combines volume and shell - the mesh should also be closed. See the picture below.



Example of the different volume init types: Volume, Shell and Both (the shell is usually slightly larger than the inner volume)

Inflow velocity

Speed of the fluid that is created inside of the object.

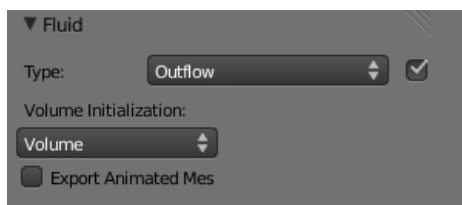
Local Coords/Enable

Use local coordinates for the inflow. This is useful if the inflow object is moving or rotating, as the inflow stream will follow/copy that motion. If disabled, the inflow location and direction do not change.

Animated Mesh/Export

Click this button if the mesh is animated (e.g. deformed by an armature, shape keys or a lattice). Note that this can be significantly slower, and is not required if the mesh is animated with position or rotation lpos (i.e. only *object* transformations).

Outflow



Fluid outflow settings

Any fluid that enters the region of this object will be deleted (think of a drain or a black hole). This can be useful in combination with an inflow to prevent the whole domain from filling up. When enabled, this is like a tornado (waterspout) or “wet vac” vacuum cleaner, and the part where the fluid disappears will follow the object as it moves around.

Volume initialization type

- Volume will initialize the inner part of the object as fluid. This works only for closed objects.
- Shell will initialize only a thin layer for all faces of the mesh. This also works for non closed meshes.
- Both combines volume and shell - the mesh should also be closed. See the picture below.



☐ Example of the different volume init types: Volume, Shell and Both (the shell is usually slightly larger than the inner volume)

Animated Mesh/Export

Click this button if the mesh is animated (e.g. deformed by an armature, shape keys or a lattice). Note that this can be significantly slower, and is not required if the mesh is animated with position or rotation lpos (i.e. only *object* transformations).

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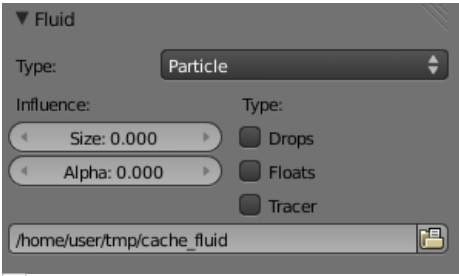
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Particle



Fluid particle settings

This type can be used to display particles created during the simulation. For now only tracers swimming along with the fluid are supported. Note that the object can have any shape, position or type - once the particle button is pressed, a particle system with the fluid simulation particles will be created for it at the correct position. When moving the original object, it might be necessary to delete the particle system, disable the fluidsim particles, and enable them again. The fluidsim particles are currently also unaffected by any other particle forces or settings.

Influence

Size Influence

The particles can have different sizes, if this value is 0 all are forced to be the same size.

Alpha Influence

If this value is >0 , the alpha values of the particles are changed according to their size.

Particle type

Drops

Surface splashes of the fluid result in droplets being strewn about, like fresh water, with low Surface Tension.

Floats

The surface tension of the fluid is higher and the fluid heavier, like cold seawater and soup. Breakaways are clumpier and fall back to the surface faster than Drops, as with high Surface Tension.

Tracer

Droplets follow the surface of the water where it existed, like a fog suspended above previous fluid levels. Use this to see where the fluid level has been.

Path (bake directory)

The simulation run from which to load the particles. This should usually have the same value as the fluid domain object (e.g. copy by CtrlC, CtrlV).

Control

Description

Using the Lattice-boltzman method, the fluid is controlled using particles which define local force fields and are generated automatically from either a physical simulation or a sequence of target shapes. At the same time, as much as possible of the natural fluid motion is preserved.

Examples

In this examples, we use the Fluid Control option to control part of the fluid so that it has a certain shape (the sphere drop or the teapot drop) before it falls in the rest of the fluid:

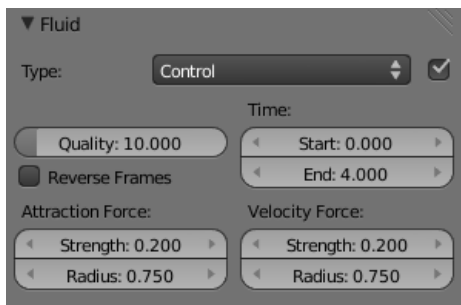


☐ Falling drop (rendered in Yafray)



☐ "Magic Fluid Control"

Options



Fluid control options.

Quality

Higher quality result in more control particles for the fluid control object.

Reverse Frames

The control particle movement gets reversed.

Time

You specify the start and end time during which time the fluid control object is active.

Attraction force

The attraction force specifies the force which gets emitted by the fluid control object. Positive force results in attraction of the fluid, negative force in avoidance.


Velocity force

If the fluid control object moves, the resulting velocity can also introduce a force to the fluid.

See also

Release notes: [Template:Release_Notes/2.48/FluidControl](#)

Animating the fluid properties

A new type of lpo Curve, FluidSim, is available for fluid domain objects. Unlike most other animatable values in Blender, FluidSim lpos cannot be keyframed by simply using the I key; you must manually set values by clicking in the lpo window. In order to set a keyframe, you must select the property you wish to animate in the lpo window and Ctrl LMB  click to set the keyframe to the desired location in the lpo window.



Enter Properties

Note that you do not have to be exact on where you click; we recommend that after you set the control point, open the Transform Properties panel (N) and round the X value to a whole frame number, and then set the Y value that you wish.

The fluid domain has several channels that control the fluid over time:

Fac-Visc

A multiplicative factor in the fluid's viscosity coefficient. It must be set before baking, and changes the viscosity of the fluid over time, so you can turn water into wi... oil, for example!

Fac-Tim

Changes the speed of the simulation; like the Speed Control in the VSE can speed up or slow down a video, this curve can speed up or slow down the fluid motion during a frame sequence. If the value for Fac-Tim is less than or equal to zero, time (and the fluid) stands still; the fluid freezes. For values between 0.0 and 1.0, the fluid runs slower and will look thicker. 1.0 is normal fluid motion, and values greater than 1.0 will make the fluid flow faster, possibly appearing thinner.

GravX/GravY/GravZ

The XYZ vector for gravity changes; aka inertia of the fluid itself (think drinking a cup of coffee while driving NASCAR at Talladega, or sipping an espresso on the autobahn, or watering the plants on the Space Shuttle). Changes in these curves make the fluid slosh around due to external forces.

The Fluid, Obstacle, Inflow, Outflow and Particle objects can use the following channels:

VelX/VelY/VelZ

Spurts of water from the garden hose can be simulated via these curves, to mimic changes in pressure and/or direction. It also can be used to simulate the effect of wind on a stream of water, for example.

Active

When Active transitions from 0.0 to something greater than 0 (such as between 0.1 and 1.0), the object's function (designated as an Inflow, or Outflow, etc.) resumes its effect. Crossing down to 0.0 and then at some point, back up, re-establishes the effect and the resulting fluid sim. Use this for dripping, or any kind of intermittent inflow. This active status also works for objects designated as Outflow and Obstacle, so you can also simulate (for example) a drain plugging up.

You can also control the force settings of Control objects:

AttrForceStr, AttrForceRa

These curves control the values of the attraction force settings.

VelForceStr, VelForceRa

These curves control the values of the velocity force settings.

Fluid Hints

Some useful hints about fluid simulation in Blender:

- Don't be surprised, but you'll get whole bunch of mesh (.obj.gz) files after a simulation. One set for preview, and another for final. Each set has a .gz file for each frame of the animation. Each file contains the simulation result - so you'll need them.
- Currently these files will not be automatically deleted, so it is a good idea to e.g. create a dedicated directory to keep simulation results. Doing a fluid simulation is similar to clicking the ANIM button - you currently have to take care of organizing the fluid surface meshes in some directory yourself. If you want to stop using the fluid simulation, you can simply delete all the `*fluid*.obj.gz` files.
- Before running a high resolution simulation that might take hours, check the overall timing first by doing lower resolution runs.
- Fluid objects must be completely inside the bounding box of the domain object. If not, baking may not work correctly or at all. Fluid and obstacle objects can be meshes with complex geometries. Very thin objects might not appear in the simulation, if the chosen resolution is too coarse to resolve them (increasing it might solve this problem).
- Note that fluid simulation parameters, such as inflow velocity or the active flag can be animated with Fluidsim lpos (see above).
- Don't try to do a complicated scene all at once. Blender has a powerful compositor that you can use to combine multiple animations.

For example, to produce an animation showing two separate fluid flows while keeping your domain small, render one .avi using the one flow. Then move the domain and render another .avi with the other flow using an alpha channel (in a separate B&W .avi?). Then, composite both .avi's using the compositor's add function. A third .avi is usually the smoke and mist and it is laid on top of everything as well. Add a rain sheet on top of the mist and spray and you'll have quite a storm brewing! And then lightning flashes, trash blowing around, all as separate animations, compositing the total for a truly spectacular result.

- If you're having trouble, or something isn't working as you think it should - let me know: send the .blend file and a problem description to [nils at thuerey dot de](mailto:nils@thuerey.de). Please check these wiki pages and the [blenderartists-forum](#) before sending a mail!

Fluid Technical Details

Physical correctness



“My cup runneth over”, created with Blender and Yafray.

Fluid animation can take a lot of time - the better you understand how it works, the easier it will be to estimate how the results will look. The algorithm used for Blender’s fluid simulation is the *Lattice Boltzmann Method* (LBM); other fluid algorithms include *Navier-Stokes* (NS) solvers and *Smoothed Particle Hydrodynamics* (SPH) methods. LBM lies somewhere between these two.

In general, it is really hard for current computers to correctly simulate even a 1-meter tank of water. For simulating a wave crashing through a city, you would probably need one of the most expensive supercomputers you could get, and it might still not work properly, no matter which of the three algorithms above you’re using. Therefore, to achieve “the effect that you really want”, you’ll need to resort to strategies very similar to what filmmakers have been doing (quite successfully...) in “analogue” movies for many years: “*fake it!*”

A good fluid simulation is a *very important* part, but not the *only* part, of achieving a satisfactory image. Let Blender do the computational dirty-work of calculating the basic fluid simulation, then create realism by adding carefully selected details that match the viewer’s expectations for “the real-life maelstrom that you have created”.

For example, you can pretend to have a wave in a gigantic city by: building a *smaller* model, modeling a *small* wave in the model at very high resolution, and hope that nobody will notice the difference between a 100m and a 1m wave (they won’t). Texture the wave front with lots of noise and clouds affecting the color. Add lots of smoke (mist) emitters on the various surfaces that the wave hits, timing each of them to emit at the moment of impact in a direction incident to the surface and collision. Animate cars and trash (and drowning people...) to float and bob on the wave front using the baked mesh. Use a string of mist emitters pointing up positioned at the wave crest to simulate the mist that blows off the top of the crest into the air. Consider exactly where you want to put the camera, whether you want to use a zoom lens or a wide angle, and so on (is the viewer to be “looking down upon the poor unfortunate actors”, or “drowning along with them”?). *This* is the kind of attention to detail, above and beyond the fluid simulation itself, that will carry the

shot.

For Blender's LBM solver, the following things will make the simulation harder to compute:

- Large domains.
- Long duration.
- Low viscosities.
- High velocities.

The viscosity of water is already really low, so especially for small resolutions, the turbulence of water can not be correctly captured. If you look closely, most simulations of fluids in computer graphics do not yet look like real water as of now. Generally, don't rely on the physical settings too much (such as physical domain size or length of the animation in seconds). Rather try to get the overall motion right with a low resolution, and then increase the resolution as much as possible or desired.

Acknowledgements

The integration of the fluid simulator was done as a Google Summer-of-Code project. More information about the solver can be found at www.ntoken.com. These Animations were created with the solver before its integration into blender: [Adaptive Grids](#), [Interactive Animations](#). Thanks to Chris Want for organizing the Blender-SoC projects, and to Jonathan Merrit for mentoring this one! And of course thanks to Google for starting the whole thing... SoC progress updates were posted here: [SoC-Blenderfluid-Blog at PlanetSoC](#).

The solver itself was developed by Nils Thuerey with the help and supervision of the following people: U. Ruede, T. Pohl, C. Koerner, M. Thies, M. Oechsner and T. Hofmann at the Department of Computer Science 10 (System Simulation, LSS) in Erlangen, Germany.

<http://www10.informatik.uni-erlangen.de/~sinihue/img/lsslogo.png>

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Text check see-also and external links

Proposed fixes: none

Fluid Appendix

Limitations & Workarounds

- One domain per blender file (as of Version 2.42), but you can have multiple fluid objects.

Workaround: For previews, move the domain around to encompass each fluid flow part, and then for final, scale up the size of the domain to include all fluid objects (but computation will take longer). This is actually a benefit, because it lets you control how much compute time is used, by varying the size and location of the domain.

- If the setup seems to go wrong, make sure all the normals are correct (hence, enter Edit mode, select all, and recalculate normals once in a while).
- Currently there's a problem with zero gravity simulation - simply select a very small gravity until this is fixed.
- If an object is initialized as Volume, it has to be closed and have an inner side (a plane won't work). To use planes, switch to Shell, or extrude the plane.
- Blender freezes after clicking BAKE. Pressing Esc makes it work again after a while - this can happen if the resolution is too high and memory is swapped to hard disk, making everything horribly slow. Reducing the resolution should help in this case.
- Blender crashes after clicking BAKE - this can happen if the resolution is really high and more than 2GB are allocated, causing Blender to crash. Reduce the resolution. Many operating systems limit the total amount of memory that can be allocated by a *process*, such as Blender, even if the *machine* has more memory installed. Sux...
- The meshes should be closed, so if some parts of e.g. a fluid object are not initialized as fluid in the simulation, check that all parts of connected vertices are closed meshes. Unfortunately, the Suzanne (monkey) mesh in Blender is not a closed mesh (the eyes are separate).
- If the fluid simulation exits with an error message (stating e.g. that the "init has failed"), make sure you have valid settings for the domain object, e.g. by resetting them to the defaults.
- To import a single fluid surface mesh you can use this script: [.bobj-Import-Script](#).
- You may not be able to bake a fluid that takes more than 1GB, not even with the LargeAddressAware build - it might be a limitation of the current fluid engine.
- Note that first frame may well take only a few hundred MBs of RAM memory, but latter ones go over one GB, which may be why your bake fails after awhile. If so, try to bake one frame at the middle or end at full res so you'll see if it works.
- Memory used doubles when you set surface subdivision from 1 to 2.
- Using "generate particles" will also add memory requirements, as they increase surface area and complexity. Ordinary fluid-sim generated particles probably eat less memory.

See also

to do

check these links, make sure they are compatible with Blender 2.6

- [Tutorial 1: Very Basic Introduction](#)
- [Tutorial 2: The Next Step](#)
- [Tutorial 1&2 Gui Changes for newer builds](#)
- [Another BSoD fluid tutorial](#)
- [Developer documentation \(implementation, dependencies, ...\)](#)

External links

to do

check these links, make sure they are compatible with Blender 2.6

- [An Introduction to Fluid Simulations in Blender \(video\)](#) ([Blendernation link](#))

Learn the basics of how to set up a fluid simulation in Blender with an obstacle.

- [Fluid Simulator Tutorial \(video\)](#) ([Blendernation link](#))

Very easy to understand video-tutorial to fluid simulation newcomers. Also covers some of the most common pitfalls.

- [Guide on Blender Fluid Simulator's Parameters](#) ([Blendernation link](#))

Smoke Simulation

Development notes

Blender's new smoke simulation is based on the paper '[Wavelet Turbulence for Fluid Simulation](#)' and associated sample code.

It has been implemented in Blender by Daniel Genrich and Miika Hamalainen.

Inner working

The simulator uses a volumetric fluid-based model, with the end results output as voxel grids. This voxel data is visualized interactively in Blender's 3D view using custom OpenGL shading, and can be rendered using the Voxel Data texture. Blender's **smoke simulation** wraps Voxels around existing [Particles](#). It requires a particle-emitting object and a 'domain' object within which smoke is rendered.

Note

This Part of the Documentation uses the 2.58 Release

User workflow

The smoke simulation is similar to the Fluid simulation: a Domain and Flow object is required to do a smoke simulation:

- set as the simulation [Domain](#) an object that defines the bounds of the simulation volume,
- set as the [Flow object](#) an object which determines where the smoke will be produced from,
- set [Collision objects](#), to make the smoke interact with objects in the scene.
- assign a [Material](#) to the smoke
- [bake](#) the simulation

In case you are having troubles, please consult the [Appendix](#)

Text

- missing smoke groups explanation
- some options are not explained at the end of the page

Proposed fixes: none

Smoke Domain

Like the Fluid Sim, most of the settings are found when the Domain Object is selected.

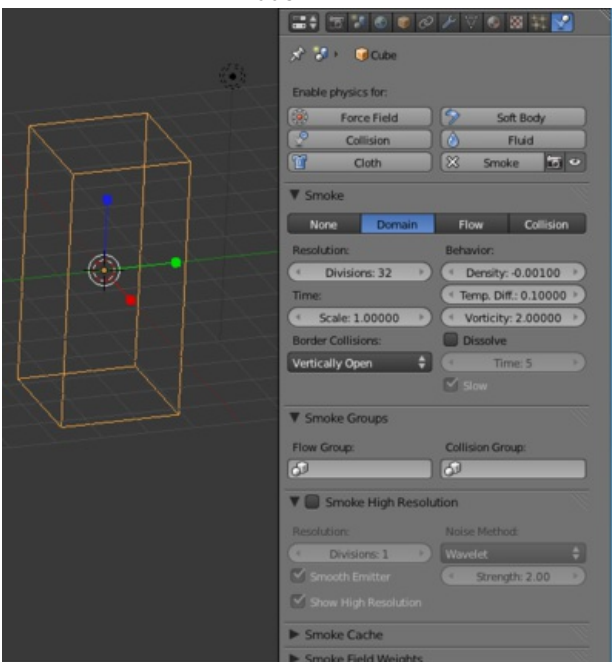
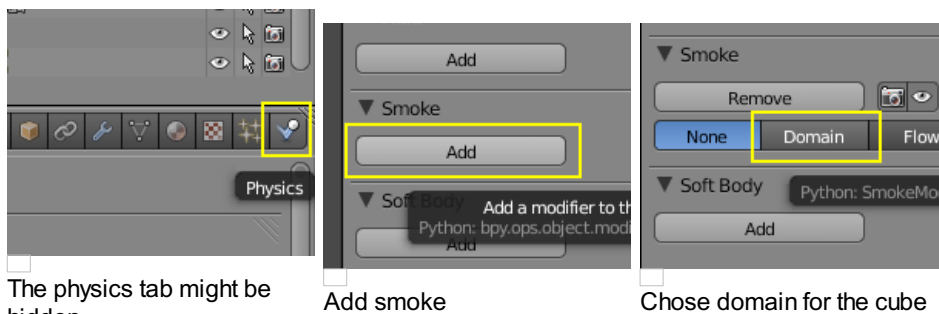
Creating the Domain

Before you can add smoke to your scene you need to define the area where the smoke simulation takes place. In Blender physics this is called a domain. A good idea is to choose a cube for that because you can scale it to the view of your camera later on. In our case we just make the default cube bigger by hitting S and dragging the mouse.

Don't edit the domain's vertices!

If you want a bigger domain, scale the object. Changing it in edit mode will lead to your smoke appearing more than once during rendering, like a repeating texture.

Make sure you're in object mode and go to the physics tab. Add smoke and chose the radio button labeled 'Domain'. For now that's all, we will return to the new settings that popped up later on.



The Smoke Domain Object

Generic options

Resolution

How detailed the smoke is. A resolution of 32 will bake in a few seconds, while a resolution of 100 can take up to a half hour on

most PC's.
Time Scale
Affects how fast the simulation plays.

Border Collisions
Vertically Open

Smoke disappears when it collides with the top and bottom of the domain.

Open

Smoke disappears when it crosses the boundaries of the domain object.

Collide All

Domain Boundaries are treated as collision objects, the smoke will collide and stay inside.

Temperature and Density
How much Density and Temperature affect smoke motion. Higher Values make faster-rising smoke.

Vorticity
Affects how turbulence/rotation, or swirly the smoke is.

Dissolve
Allow the smoke to dissipate over time.

Time
The speed of the smoke's dissipation.

Slow
Use $1/\text{Time}$ instead of Time, making the smoke dissolve slower.

Smoke Groups options

to do

Smoke High Resolution options

The High Resolution option lets you simulate at low resolution and then uses noise techniques to enhance the resolution without actually computing it. This allows animators to set up a low resolution simulation quickly and later add details without changing the overall fluid motion.

Various methods for this are available, including the default: Wavelet, which is an implementation of 'turb.phpWavelet Turbulence for Fluid Simulation'

Resolution/Divisions
Enhance the resolution of smoke by this factor using noise.

Smooth Emitter
Smoothens emitted smoke to avoid blockiness.

Show High Resolution
Show high resolution using amplification.

Noise Method
Wavelet

FFT

Strength
Strength of noise.

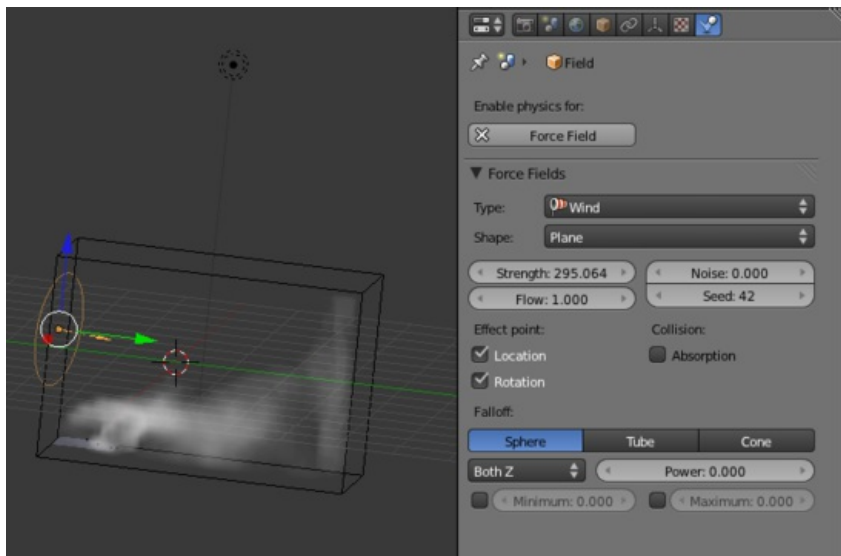
Smoke Field Weights options

Determines how much various forces and force fields affect the smoke.

Gravity
How much the smoke is affected by Gravity.

All
Changes the overall influence of all force fields.

The other settings determine how much various Force Fields affect the smoke.



Images need the settings panel image

Proposed fixes: none

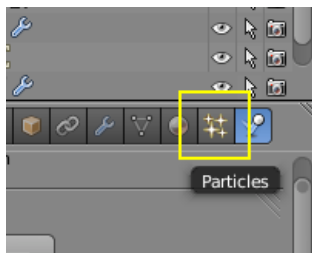
Smoke Flow object

Create a Flow Object

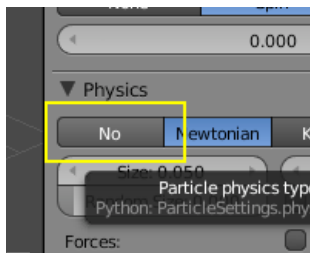
Once you have defined the volume that will contain smoke, we'll add an object from which the smoke will be emitted. Add another cube and make sure it's inside the domain cube (⇧ ShiftA » Mesh » Cube; 3D view must be selected).

While in edit mode go to physics and add smoke to the small cube, too. This time chose Flow.

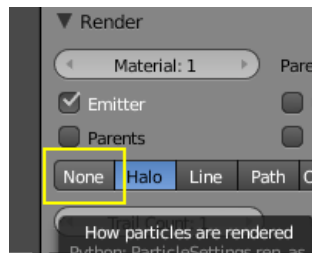
The smoke will not be emitted from the object itself but from particles the object emits. So we need to set up a particle system. With the small cube still selected go to the particle tab. Add a new particle system and turn off the physics because we want our smoke emit from stationary place. We also don't want to see the particles so turn off the render, too.



The particles tab is right next to the physics tab

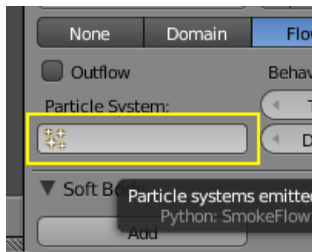


We don't want the particles to be affected by physics

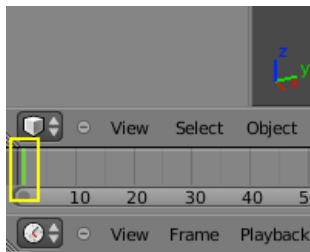


We also don't want to see the particles

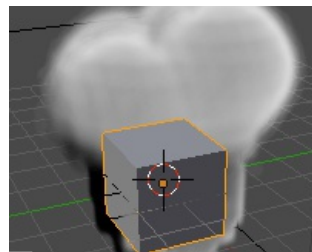
Now go back to the physics tab and chose the particle system in the smoke section. There should be a list with just one system to chose from that is called 'ParticleSystem' since we did not change the name. Now you can scrub through the timeline to see smoke coming from the cube. Another way to preview the smoke is starting the animation by AltA (stop it the same way).



Select the newly created particle system here



Either scrub on the timeline or use ALT+A



Now there should be smoke in the viewport

Settings

Outflow

Delete smoke from simulation.

Particle System

Particle system emitted from the object.

Initial Velocity

Smoke inherits its velocity from the emitter particle.

Multiplier

Multiplier to adjust velocity passed to smoke.

Initial Values

Absolute Density

Only allow given density value in emitter area.

Density

Initial density value.

Temp. Diff.

Temperature to ambient temperar.

Page status ([reviewing guidelines](#))

Images needs the settings panel image

Proposed fixes: none

Collisions

Smoke can collide with mesh objects, using the 'Collision' option in smoke. Currently only static collision objects are supported.

Forces

Blender's force fields (such as wind or vortex fields) are also supported, modifying the smoke simulation as they do for other physics systems such as particles.

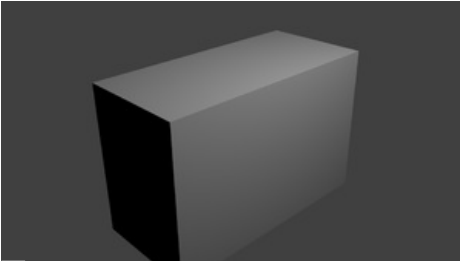
Page status ([reviewing guidelines](#))

Page reviewed and in good shape

Smoke Material

Create the Material

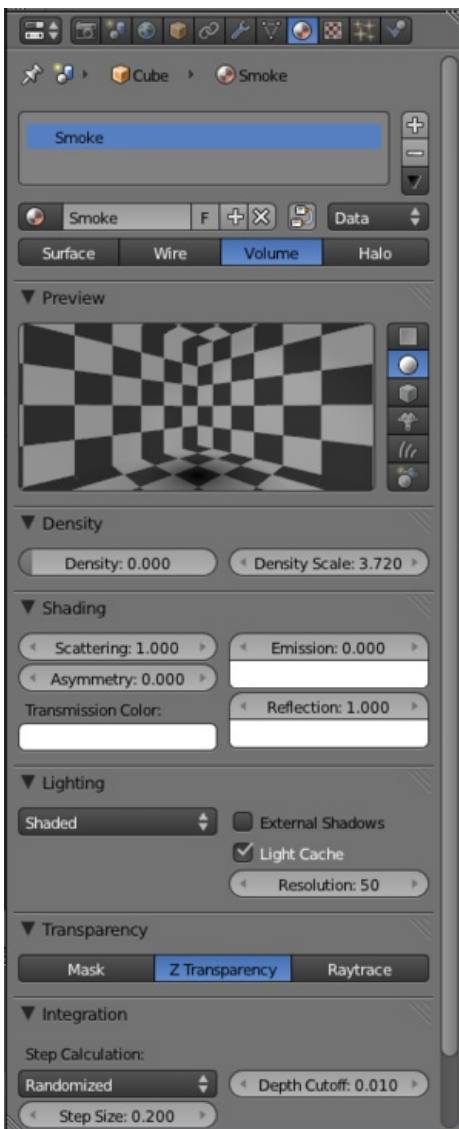
Simulating the smoke is easy, however rendering it is not.



The Render without the correct smoke material.

Rendering at this point will result in just the big cube (Image, F12) or in a crash (Animation, CtrlF12).

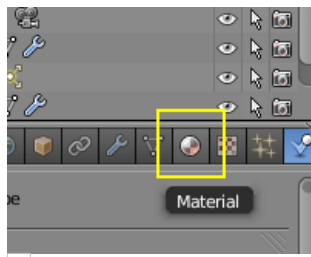
The material must be a volumetric material with a Density of 0, and a high Density Scale.



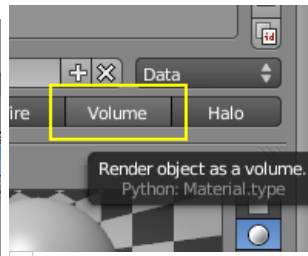
The material settings.

The first issue can easily be fixed by working on the material and texture of the domain cube. Smoke requires a complex material to

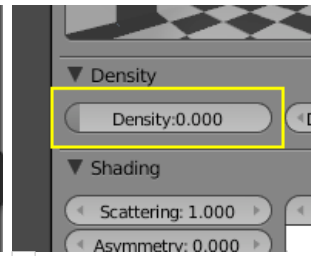
render correctly. Select the big cube and go to the material tab. There change the material to 'Volume' and set the density to 0. If you set the density to values bigger than 0 the domain cube will be filled with the volume material. The [other settings](#) will affect the smoke, though. We'll cover those later.



Go to the material tab



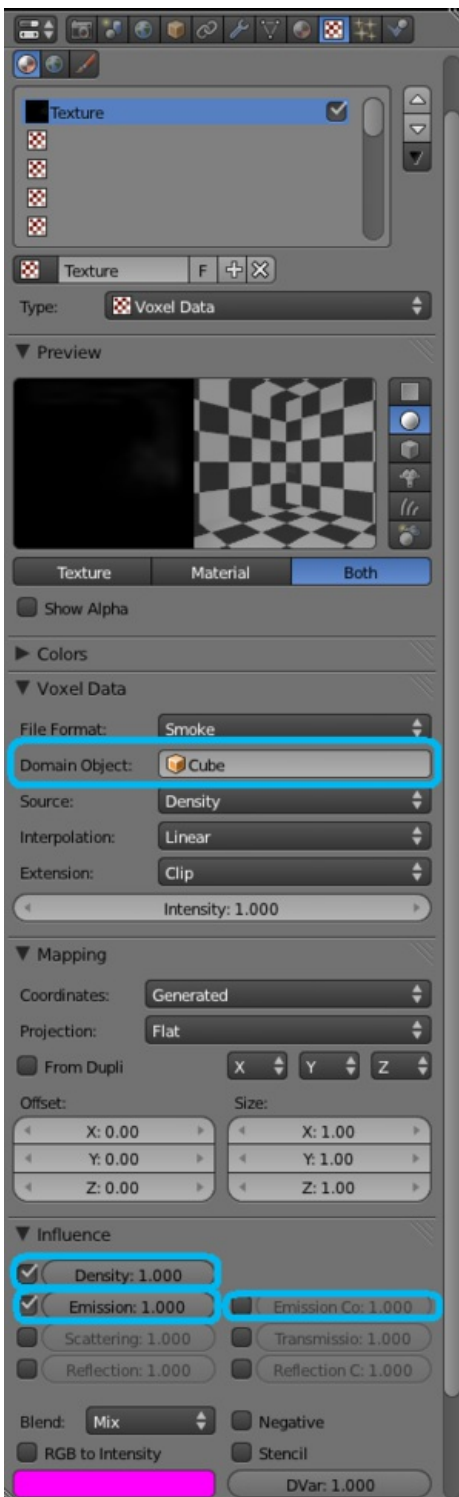
Smoke needs a volume material



Density applies to the cube only, so we need to set it to 0

Add the Texture

In addition, Smoke requires its own texture. Blender 2.5 has a new texture just for rendering smoke called [Voxel Data](#). You must remember to set the domain object and change the influence.

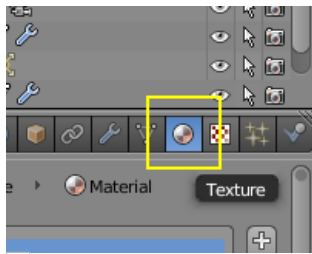


The texture settings.

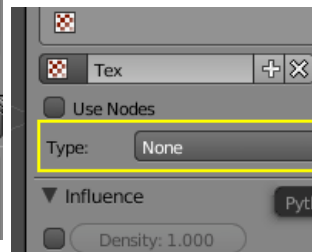
Go to the texture tab and change the type to 'Voxel Data'. Under the Voxel Data-Settings set the domain object to our domain cube (it should be listed just as 'Cube' since we are using Blender's default cube. Under Influence check 'Density' and leave it at 1.000 (Emission should be automatically checked, too). Now you should be able to render single frames. You can choose to color your smoke as well, by turning "Emmision Color" back on.

💡 To see the smoke more clearly

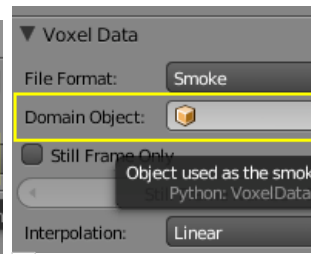
Under the world tab, chose a very dark color for the horizon.



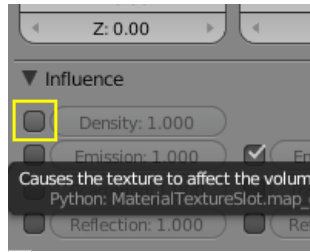
We need to add a texture of the smoke



Type should be Voxel Data



The domain is once again our big cube



Use density as influence



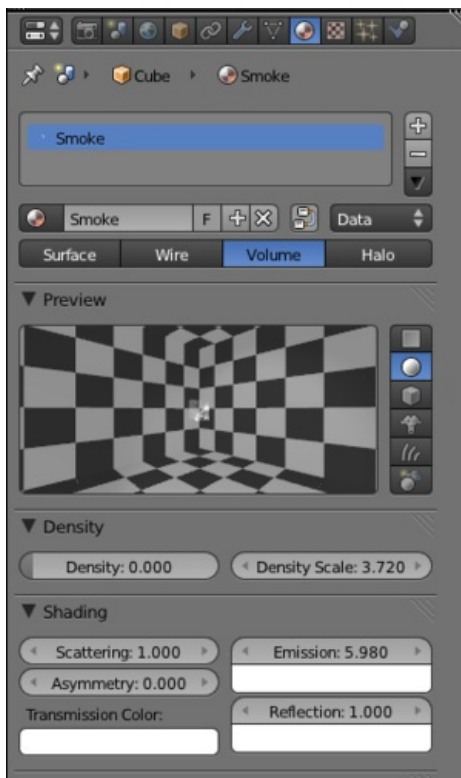
Finally your first smoke render :)



The rendered smoke. It's hard to see, but it's there.

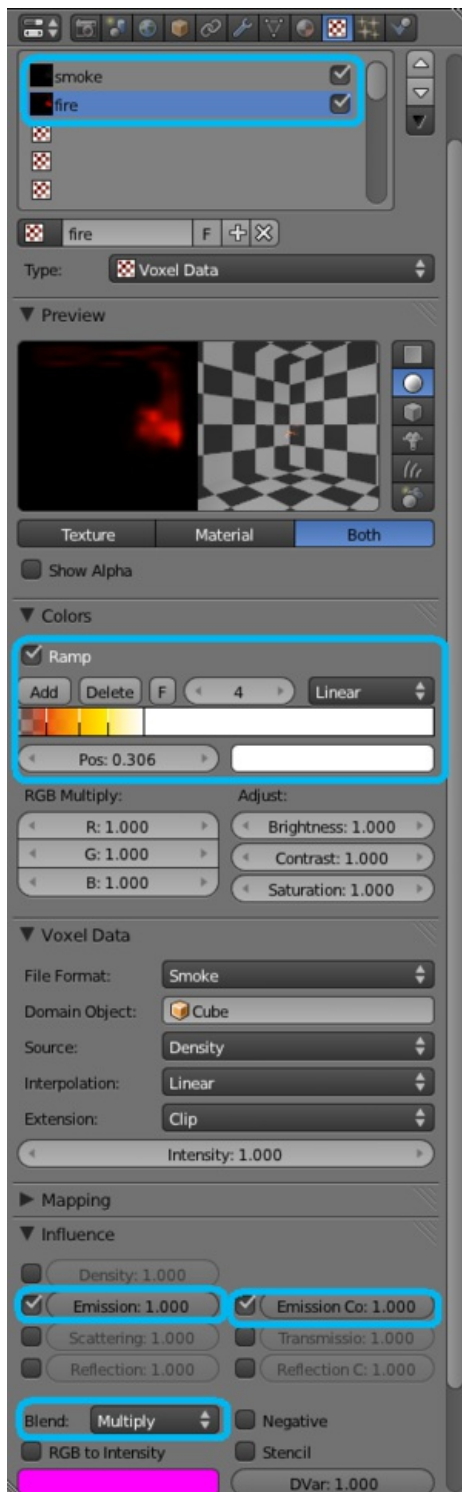
Extending the Smoke Simulator: Fire!

You can also turn your smoke into fire with another texture! To make fire, turn up the Emmission Value in the Materials panel.

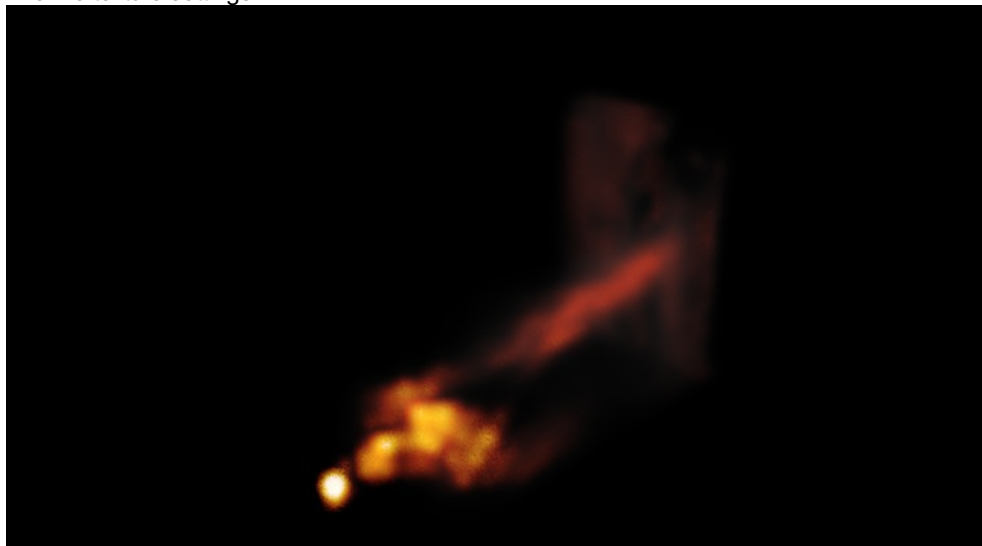


The Fire material.

Then, add another texture (Keep the old texture or the smoke won't show). Give it a fiery color ramp- which colors based on the alpha, and change the influence to emission and emission color. Change the blend to Multiply.



The fire texture settings.





The fire render.

Page status ([reviewing guidelines](#))

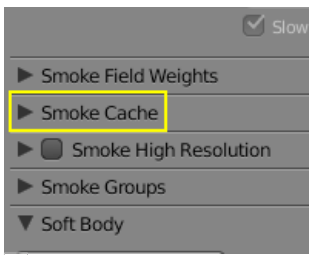
Page reviewed and in good shape

Baking Smoke Simulations

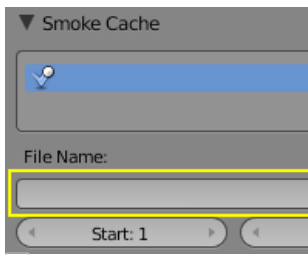
If you want to render an animation, you need to bake your smoke first. Baking is simply calculating a simulation. To bake the smoke, the file must be saved. The calculations are stored in a cache file which can be named. On occasion, Baking may crash Blender. [See [troubleshooting](#)]

By scrubbing through the timeline or running the animation in the viewport via AltA you already did some realtime-baking to the memory. But for rendering the animation, the baked data must be on disk. And before you can bake, you need to save your Blendfile.

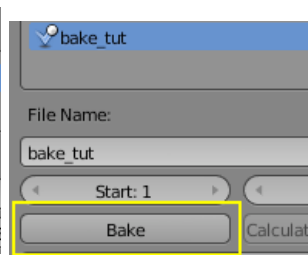
Next select the domain cube and go to the physics tab where you open the Smoke Cache section. Give your cache a file name by entering it into the text box and hitting ↵ Enter. By hitting Bake your simulation data is computed and stored to disk. Notice that the scrubbing-bug in the timeline is gone now? At this point you should be able to render the animation.



Go to the cache section of your smoke domain



The files on disk need a name



Finally we're ready to bake

Smoke Appendix

Troubleshooting

- **Q.** Blender Crashes when I push the Domain Button of a smoke simulation!
- **A.** This is caused by outdated drivers. Update your Drivers.
- **Q.** Blender Crashes when Smoke Simulations bake!
- **A.** You ran out of RAM to compute it. Try Baking at a lower resolution.
- **Q.** The smoke isn't rendering!
- **A.** Go back and read the documentation.
- **Q.** When I try to make fire, it gives me strange results, or doesn't show up.
- **A.** Make sure you have a high emission Value for the Material, and that you have a Smoke Density texture, and that you set the fire texture to Multiply.

External links

- [In-Depth introduction to smoke and fire in Blender 2.5 covering most of the pitfalls](#)
- [Guide to realistic fire in Blender by MiikaH](#)

Page status ([reviewing guidelines](#))

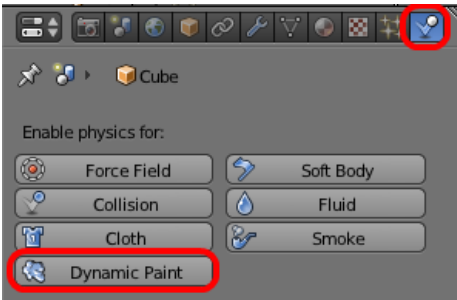
Text add more examples of possible effects (also some vid) and move the how-to-activate explanation in a new page

Proposed fixes: none

Dynamic Paint

Dynamic paint is a new modifier and physics system that can turn objects into paint canvases and brushes, creating vertex colors, image sequences or displacement. This makes many effects possible that were previously difficult to achieve, for example footsteps in the snow, raindrops that make the ground wet, paint that sticks to walls, or objects that gradually freeze.

This guide explains the very basics of Dynamic Paint user interface and general features.



How to activate the Dynamic Paint

Activating the modifier

Dynamic Paint can be activated from the "Physics" tab of the "Properties" editor.

Types

Modifier itself has two different types:

Canvas

Makes object receive paint from Dynamic Paint brushes.

Brush

Makes object apply paint on the canvas.

Note

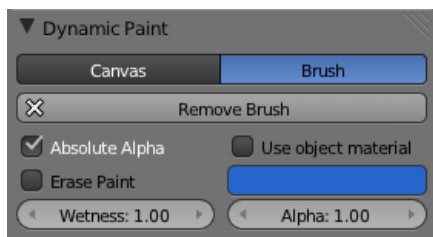
You can also enable brush and canvas simultaneously. In that case same object's "brush" doesn't influence it's "canvas", but can still interact with other objects in the scene.

See also

- [A step-by step introduction](#)
- [A detailed guide that covers every setting with images and examples](#) (Currently not up-to-date)

Dynamic Paint Brush

Main Panel



Brush main panel

From the first brush panel you can define how brush affects canvas color surfaces.

Absolute Alpha

This setting limits brush alpha influence. Without it, brush is "added" on surface over and over again each frame, increasing alpha and therefore influence of brush on canvas. In many cases however, it's preferred to not increase brush alpha if it already is on brushes level.

Erase Paint

Makes brush dissolve exiting paint instead of adding it.

Wetness

Defines how "wet" new paint is. Wetness is visible on "Paint" surface "wetmap". Speed of "Drip" and "Spread" effects also depends on how wet the paint is.

Use object material

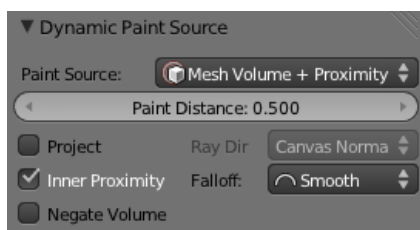
When enabled, you can define a material to be used as brush color. This includes material's base color and all textures linked to it, eventually matching the rendered diffuse color. This setting is only available when using "Blender Internal" renderer at the moment.

Otherwise you can define a color for the brush from the color box below.

Alpha

Defines brush alpha or visibility. Final wetness is also affected by alpha.

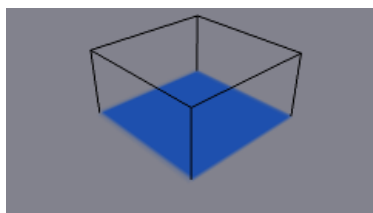
Source Panel



Brush source panel

Brush "Source" setting lets you define how brush influence/intersection is defined.

There are currently five brush behavior types to choose from, each having individual settings for further tweaking:



Brush Source - Volume

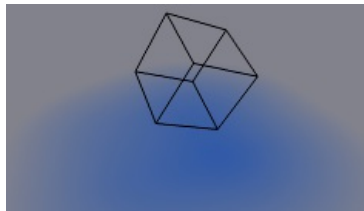
Mesh Volume

This the default option. Brush affects all surface point inside the mesh volume.

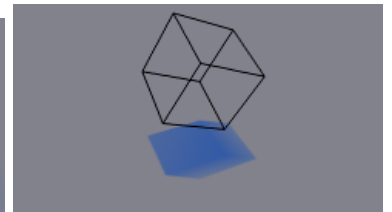
Proximity

Only uses defined distance to the closest point on brush mesh surface. Note that inside of the volume is not necessarily affected because it's not close to the surface.

Proximity falloff type can be "Smooth", "Sharp" or tweaked with a color ramp.



Brush Source - Proximity. Brush affects all canvas pixels around it



"Project" setting enabled. See how brush only affects canvas in normal direction

Project

Projects brush to the canvas from a defined direction. Basically this can be considered as "direction aligned" proximity.

Mesh Volume + Proximity

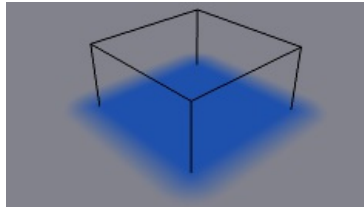
Same as volume type, but also has influence over defined distance. Same falloff types as for "Proximity" type are available.

Inner Proximity

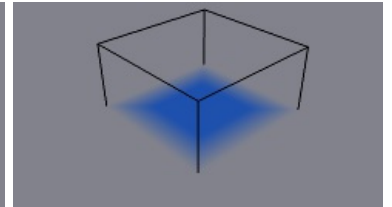
Applies proximity inside the mesh volume.

Negate Volume

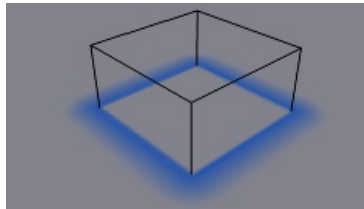
Negates brush alpha within mesh volume.



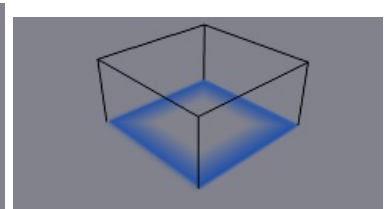
"Volume + Proximity" brush with no additional settings



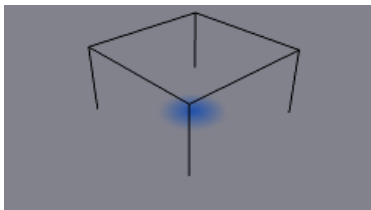
Inner Proximity. Proximity falloff is now visible inside the volume



Negate Volume. Inner side of the volume has become completely transparent



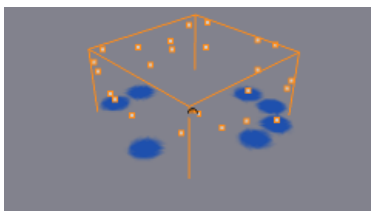
Inner Proximity and Negate Volume enabled together



Brush Source - Object Center

Object Center

Instead of calculating proximity to the brush object mesh, which can be quite slow in some cases, only distance to only center is calculated. This is much faster and often good enough.

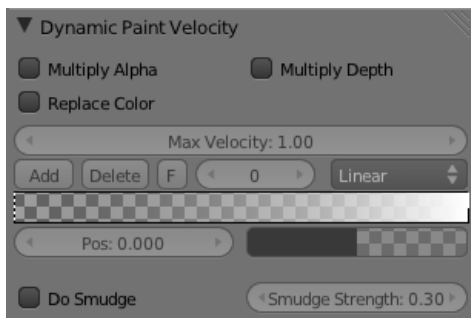


Brush Source - Particle System

Particle System

Brush influence is defined by particles from a selected particle system.

Velocity Panel



Velocity panel

This panel shows brush options that are based on object velocity.

On top you have a color ramp and several related settings. Basically the color ramp represents brush velocity values: left side being zero velocity and right side being the "Max velocity". Speed is measured in "Blender units per frame".

Tick boxes above can be used to define color ramp influence.

Multiply Alpha

Uses color ramp's alpha value depending on current velocity and multiplies brush alpha with it.

Replace Color

Replaces the brush color with the ramp color.

Multiply Depth

Multiplies brushes "depth intersection" effect. Basically you can adjust displace and wave strength depending on brush speed.

Smudge settings

Enabling Smudge makes the brush "smudge" (or "smear") existing colors on the surface as it moves. The strength of this effect can be defined from the "Smudge Strength" property.

Even when smudge is enabled brush still does it's normal paint effect. If you want a purely smudging brush use zero alpha. It's also possible to have "Erase" option enabled together with smudge.

Waves Panel



Brush Waves panel

This panel is used to adjust brush influence to "Wave" surfaces.

You can use "Wave Type" menu to select what effect this brush has on the wave simulation. Below are two settings for further adjustments.

Factor

Adjusts how strongly brush "depth" affects the simulation. You can also use negative values to make brush pull water up instead of down.

Clamp Waves

In some cases the brush goes very deep inside the surface messing whole simulation up. You can use this setting to "limit" influence to only certain depth.

There are four "Wave Type" options available:

Depth Change

This option makes brush create waves when the intersection depth with the surface is *changed* on that point. If the brush remains still it won't have influence.

Using a negative "Factor" with this type can create a nice looking "wake" for moving objects like ships.

Obstacle

Constantly affects surface whenever intersecting. Waves are also reflected off this brush type. However, due the nature of wave simulation algorithm this type creates an unnatural "dent" in the surface if brush remains still.

Force

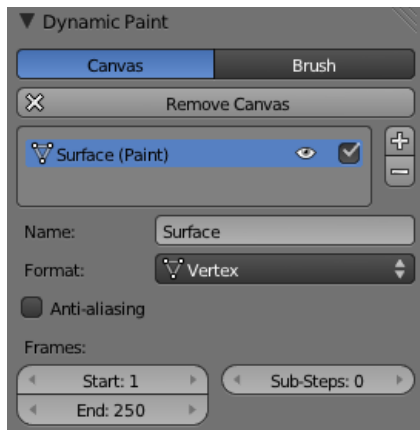
Directly affects the velocity of wave motion. Therefore the effect isn't one to one with brush intersection depth, yet the force strength depends on it.

Reflect Only

This type has no visible effect on the surface alone but reflects waves that are already on the surface.

Dynamic Paint Canvas

Main Panel



Canvas main panel

The first panel of canvas contains the list of Dynamic Paint surfaces. These surfaces are basically layers of paint, that work independently from each other. You can define individual settings for them and bake them separately.

If surface type/format allows previewing results in 3D-viewport, an eye icon is visible to toggle preview.

The checkbox toggles whether surface is active at all. If not selected, no calculations or previews are done.

You can also give each surface an unique name to easily identify them.

Below you can set surface type and adjust quality and timing settings.

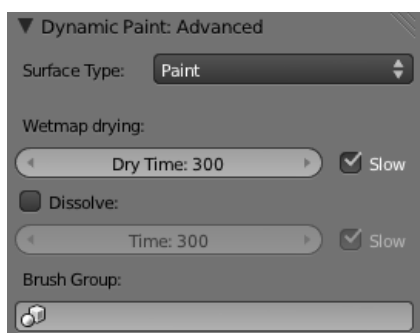
Each surface has a certain format and type. Format determines how data is stored and outputted. Currently there are two formats available:

- Image Sequences. Dynamic Paint generates UV wrapped image files of defined resolution as output.
- Vertex. Dynamic Paint operates directly on mesh vertex data. Results are stored by point cache and can be displayed in viewports. However, using vertex level also requires a highly subdivided mesh to work.

From quality settings you can adjust image resolution (for image sequences) and anti-aliasing.

Then you can define surface processing start and end frame, and number of used sub-steps. Sub-steps are extra samples between frames, usually required when there is a very fast brush.

Advanced Panel



Canvas advanced panel

From "Advanced" panel you can adjust surface type and related settings.

Each surface has a "type" that defines what surface is used for. Available types are:

- Paint
- Displace
- Waves
- Weight

Common options

For each surface type there are special settings to adjust. Most types have the settings *Dissolve* and *Brush*:

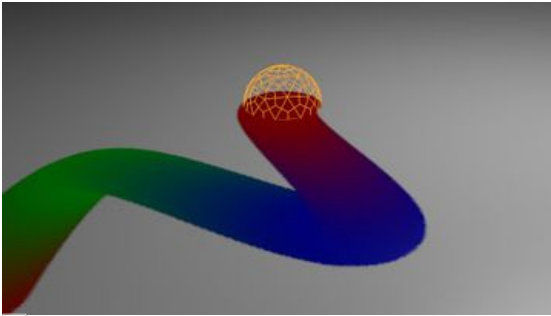
Dissolve

used to make the surface smoothly return to its original state during a defined time period

Brush Group

used to define a specific object group to pick brush objects from

Paint

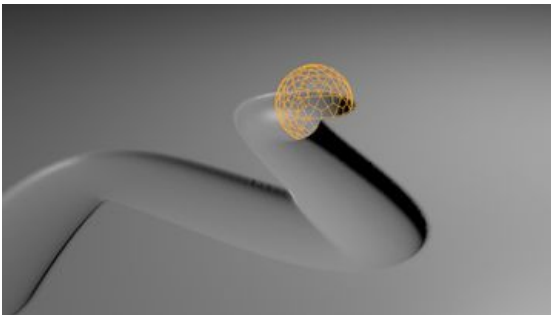


Paint Surface

"Paint" is the basic surface type that outputs color and wetness values. In case of vertex surfaces results are outputted as vertex colors.

Wetmap is a black-and-white output that visualizes paint wetness. White being maximum wetness, black being completely dry. It is usually used as mask for rendering. Some "paint effects" affect wet paint only.

Displace



Displace Surface

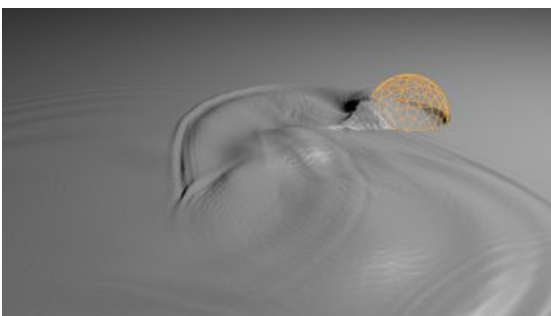
This type of surface outputs intersection depth from brush objects.



Tip

If the displace output seems too rough it usually helps to add a "Smooth" modifier after Dynamic Paint in the modifier stack.

Waves



Waves Surface

This surface type produces simulated wave motion. Like displace, wave surface also uses brush intersection depth to define brush strength.

You can use following settings to adjust the motion:

Open Borders

Allows waves to pass through mesh "edges" instead of reflecting from them.

Timescale

Directly adjusts simulation speed without affecting simulation outcome. Lower values make simulation go slower and otherwise.

Speed

Affects how fast waves travel on the surface. This setting is also corresponds to the size of the simulation. Half the speed equals surface double as large.

Damping

Reduces the wave strength over time. Basically adjusts how fast wave disappears.

Spring

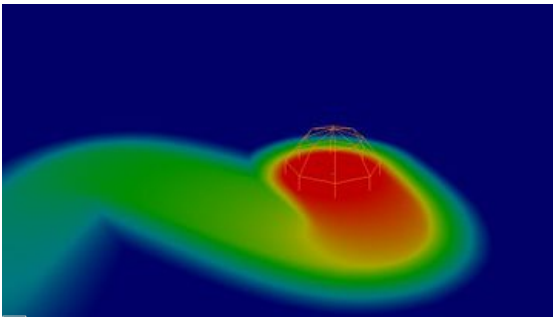
Adjusts the force that pulls water back to "zero level".



Tip

In some cases the wave motion gets very unstable around brush. It usually helps to reduce wave speed, brush "wave factor" or even the resolution of mesh/surface.

Weight



Weight Surface

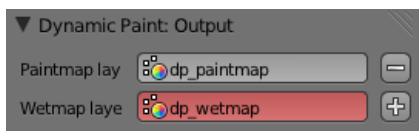
This is a special surface type only available for vertex format. It outputs vertex weight groups that can be used by other Blender modifiers and tools.



Tip

It's usually preferred to use "proximity" based brushes for weight surfaces to allow smooth falloff between weight values.

Output Panel



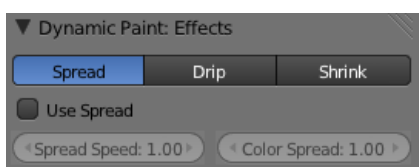
Canvas output panel

From "Output" panel you can adjust how surface outputs its results.

For "Vertex" format surfaces, you can select a mesh data layer (color / weight depending on surface type) to generate results to. You can use the "+" / "-" icons to add/remove a data layers of given name. If layer with given name isn't found, it's shown as red.

For "Image Sequence" surfaces, you can define used "UV Layer" and output file saving directory, filenames and image format.

Effects Panel



Canvas effects panel

This is a special feature for "Paint" type surface. It generates animated movement on canvas surface.

Currently there are 3 effects available:

Spread

Paint slowly spreads to surrounding points eventually filling all connected areas.

Drip

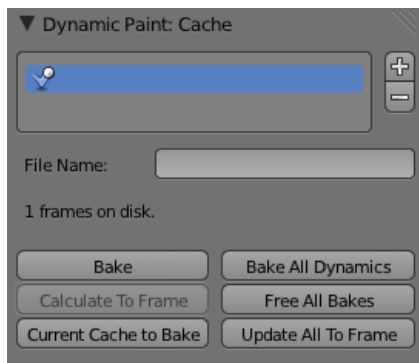
Paint moves in specific direction specified by Blender force fields, gravity and velocity with user defined influences.

Shrink

Painted area slowly shrinks until disappears completely.

For spread and drip effects, only "wet paint" is affected, so as the paint dries, movement becomes slower until it stops.

Cache Panel



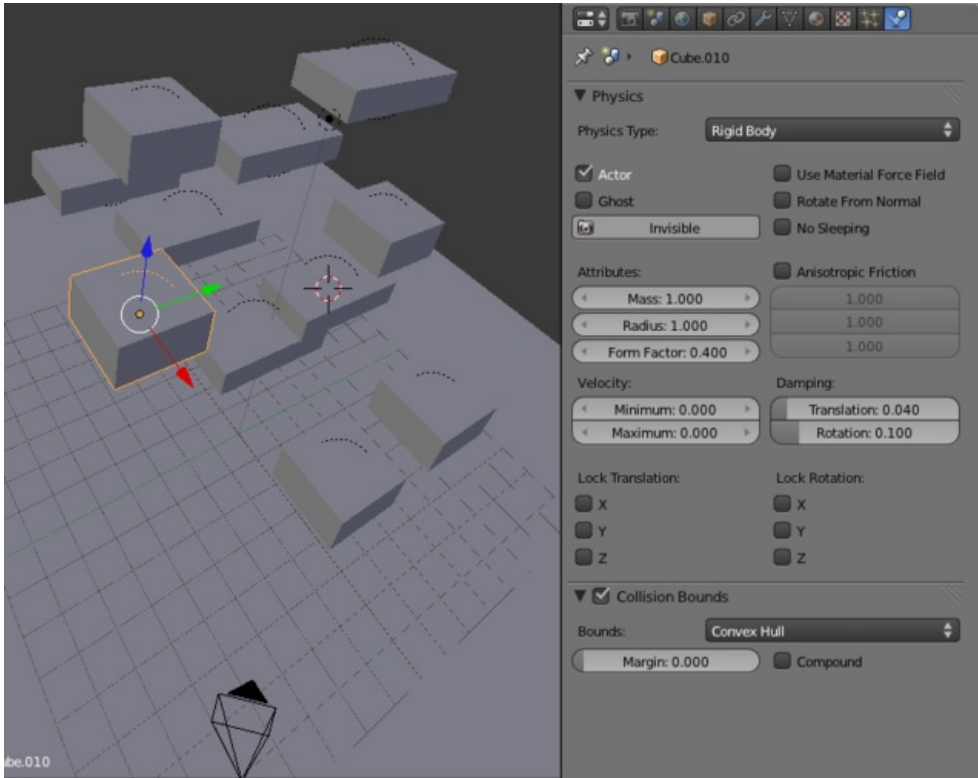
Canvas cache panel

This panel is currently only visible for "vertex" format surfaces. You can use it to adjust and bake point cache.

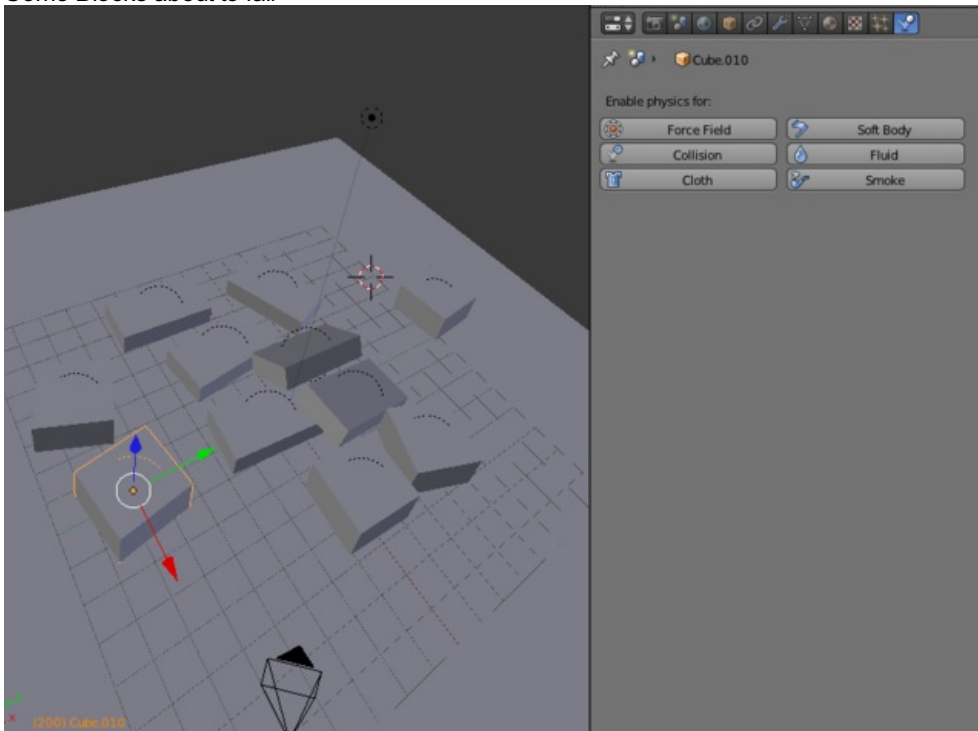
Converting Game Engine Physics

Sometimes, you may want to animate a wall being broken down by an object, or a bunch of objects collapsing, falling, or bouncing with accurate physics. You could manually insert keyframes and do trial and error adjusting with F-Curves to simulate physics and acceleration, or, you can do it much easier and automatically by taking advantage of Blender Game Engine Physics. Blender now has a feature which allows you to record animation in a blender game and turn it into Blender Animation Keyframes.

Animation can be recorded by going Game>Record Animation. The animation can then be recorded with Alt+A



Some Blocks about to fall



A Pile

If you just want a static pile of stuff, you can move to the last frame, and delete all the keyframes quickly by turning them into NLAs and deleting.

Simulation performance adjustments

OpenMP (Mac OSX)

How to use the distributed applescript to optimize simulation performance on OSX

Suboptimal baking performance

Often you will encounter suboptimal baking performance with openMP (OMP) multithreaded simulations, especially fluids.

This is due how the domain splitting distributes threads to cells which are sometimes not "filled" whereas calculations, resulting in lot of threads not giving any speedboost. This is almost dependent on the resolution the simulation and object density.

If you have such an "undersaturated" simulation, it helps a lot to just reduce the OMP threads to a low number instead of letting OMP just use all available cores.


Solution

For OSX openMP-enabled Blender you can now use a delivered applescript to tune the OMP-threads used. This makes usage of the terminal obsolete.

The default is for now set to 4 cores.

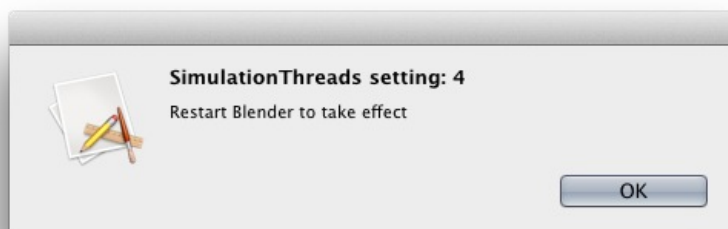
If you leave the input field empty, the script gets the corecount of your logical cpu-cores (including HyperTrading) This is the same what openMP would pull without the environment variable set.

Steps to use the applescript

1. In your Blenderfolder open the "set_simulation_threads" applescript  `set_simulation_threads`
2. Set the threadcount you want to use (leave empty to let OMP get all available cores)



3. Press o.k. to set the new value, a messagebox will show you the new setting accepted.



4. Close and reopen Blender to take over the setting.
5. Watch your baking progress or simulation framerates and perhaps repeat steps 1- 4 to get the optimal value.

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Physics/Performances>"

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Motion Tracking

Introduction

Motion tracking is a new technique available in Blender. It is still under development, and currently supports basic operations for camera tracking only. But it's already ready to be used in production.

Getting started

Motion tracking is available in current SVN Trunk and would be included into Blender 2.61 release. It's enabled by default for all platforms and can be used "out-of-box".

Here's brief descriptions of tools of motion tracking currently available in Blender

Supervised 2D tracking

There's no common algorithm which can be used for all kinds of footage, feature points and their motions. Such algorithms can be constructed, but it'll be really slow and it can still fail, so the only way to perform 2D tracking is to manually choose the algorithm of tracking and it's settings. Current defaults would work nice for general footage which isn't very blurry and where feature points aren't getting highly deformed by perspective, i.e.

Improving 2D tracking is already in our TODO list, but it's not high priority at this moment. If you aren't sure about algorithms and settings and don't want to read this document, you can just play with settings and find one which would work for you.

Manual lens calibration using grease pencil and/or grid

All cameras record distorted videos. Nothing can be done about this because of the manner in which optical lenses work. For accurate camera motion, the exact value of the focal length and the "strength" of distortion are needed.

Currently, focal length can be automatically obtained only from the camera's settings or from the EXIF information -- there are no tools inside Blender which can estimate it. But there are some tools which can help to find approximate values to compensate for distortion. There are also fully manual tools where you can use grid which is getting affected by distortion model and deformed cells defines straight lines in the footage. You can also use grease pencil for this - just draw line which should be straight on the footage using poly line brush and adjust distortion values to make grease pencil match lines on the footage.

To calibrate your camera more accurately, use the grid calibration tool from OpenCV. OpenCV is using the same distortion model, so it shouldn't be a problem.

Camera motion solving

Despite that there's no difference in solving camera motion and object motion from math's point of view, only camera solving is currently supported. And it still has some limitations, like unsupported solve of tripod motions or dominant plane motions (where all track-able features belong to one plane). These limitations are planned to be solved in the future.

Basic tools for scene orientation and stabilization

After solve, something is needed to orient real scene in 3D scene for more convenient compositing. There's tools to define floor, scene origin, and X/Y axis to perform scene orientation.

If something is needed to stabilize video from camera to make the final result looks nicer, 2D stabilization is available to help. It stabilizes video from camera which can compensate camera jumps and tilt.

Basic nodes for compositing scene into real footage

Some new nodes were added to compositor to composite scene into footage in easier way. So, there are nodes for 2D stabilization, distortion and undistortion which are easy to use.

Not implemented tools

Some tools aren't available in Blender yet, but they are in our TODO list. So there's currently no support for such things as rolling shutter filtering, object motion solving, motion capturing. But you can try to hack this stuff using currently implemented things.

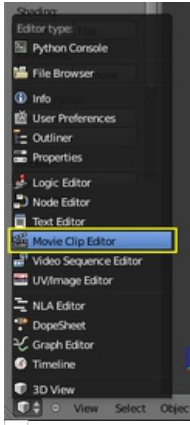
Manual

Movie Clip Editor

Almost all motion tracking tools are concentrated in editor called Movie Clip Editor. Currently it doesn't have any tools which aren't

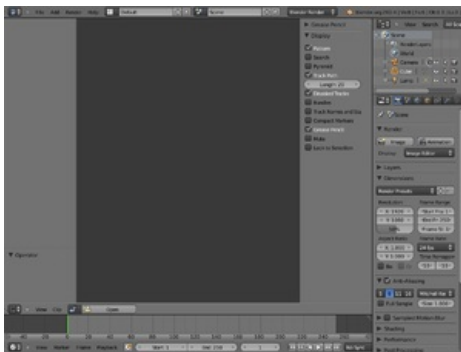
related on motion tracking, but in feature it can be expanded to be used for masking and so, that's why it's called in this more abstract from motion tracking manner.

This editor can be found in list of editor types.



Editor type menu

When you'll switch to Movie Clip Editor interface would change in the following way.



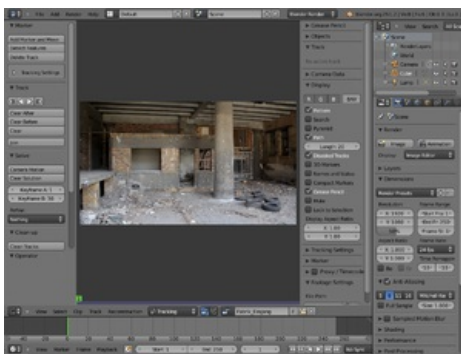
Movie Clip Editor interface

Next thing which is logical to do is to open new video clip to start working with. There are several ways to to this:

- Use **Open** button from movie editor header
- Use Clip » Open menu
- Use AltO> shortcut

Both of movie files and image sequences can be used in the clip editor. If you're using image sequence there's one limitation on naming of files: last group of numbers should be increasing continuously.

So, when movie clip is loaded into clip editor, extra panels are displayed in the interface.



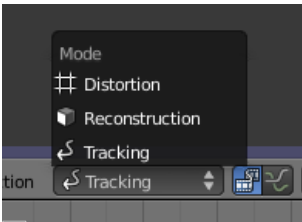
Movie Clip Editor with opened clip

There are plenty of new tools appeared on the screen and here's short description of all of them.

First of all, it should be mentioned, that camera solver consists of three quite separated steps:

- 2D tracking of footage
- Camera intrinsics (focal length, distortion coefficients) specification/estimation/calibration
- Solving camera, scene orientation, scene reconstruction

Tools in clip editor are split depending on step they're used at, so interface isn't messed up with scene orientation tools when only 2D tracking can be done. Currently displayed tools category can be changed using Mode menu which is in editor header.





Movie Clip Editor mode menu


But almost all operators can be called from menus, so it's not necessary to change mode every time you want to use a tool which is associated with a different editor mode.

In tracking mode only tools which are related on tracking and camera solving are displayed. Camera solving tools are exposed here because it's after solving you'll most probably want to re-track existing tracks or place new tracks to make solving more accurate.

Tools available in tracking mode

Markers panel

- **Add Marker and Move** operator places new marker at the position of mouse (which is under the button in this case, not ideal but it's just how things work) and then it can be moved to needed location. When it's moved to needed position, LMB  can be used to finish placing new marker. Also,  Enter and Space can be used to finish placing marker.

But it's faster to use Ctrl LMB  to place markers directly on the footage. This shortcut will place marker on place you've clicked. One more feature here: until you've released mouse button you can adjust marker position moving mouse and using track preview widget to control how accurate marker is placed.

- **Detect Features** operator detects all possible to features on current frame and places markers at this features. This operator doesn't take in account other frames, so it can place markers on features which belongs to moving object and if camera is turning away from this shot, no markers would be placed on frames after camera moved away.

There are several properties for this operator:

Placement is used to control where to place marker. By default, they'll be added on the whole frame, but you can also outline some interesting for detecting areas with grease pencil and place markers only inside outlined area. That's how "Inside Grease Pencil" placement variant works. You can also outline absolutely not interesting areas (like trees, humans and so) and place markers outside of this areas. That's how "Outside Grease Pencil" placement variant works.

Margin controls distance from image boundary for created markers. If markers would be placed too close to image boundary, they'll fail to track really soon and they should be deleted manually. To reduce amount of manual cleaning up this parameter can be used.

Trackability limits minimal trackability for placing markers. This value came from feature detection algorithm and basically it means: low values means most probably this feature would fail to track very soon, high value means it's not much such track. Amount of markers to be added can be controlled with this value.

Distance defines minimal distance between placed markers. it's needed to prevent markers placed too close to each other (such placement can confuse camera solver).

- **Delete Track** is quite self-explaining operator which deletes all selected tracks.

Track panel

- First row of buttons is used to perform tracking of selected tracks. Tracking can happen (in order of buttons):
 - Backward one frame
 - Backward along the sequence
 - Forward along the whole sequence
 - Forward one frame

This operator depends on settings from Tracking Settings panel which would be described later.

If during sequence tracking algorithm returned failure of tracking some markers, they'll be disabled and tracking will continue for rest of markers. If algorithm returns failure when tracking frame-by-frame, marker wouldn't be disabled and most possible position of feature on new frame would be used.

- **Clear After** deletes all tracked and keyframed markers after current frame for all selected tracks.
- **Clear Before** deletes all tracked and keyframed markers before current frame for all selected tracks.
- **Clear** clears all markers except current from all selected tracks.
- **Join** operator joins all selected tracks into one. Selected tracks shouldn't have common tracked or keyframed markers at the same frame.

Solve panel

Camera Motion operator solves motion of camera using all tracks placed on the footage and two keyframes specified on this panel. There are some requirements:

- There should be at least 8 common tracks on the both of keyframes
- It should be well noticeably parallax effect between this two keyframes

If everything came smooth during solve, average reprojection error would be reported to the information space and to clip editor header. Reprojection error means average distance between reconstructed 3D position of tracks projected back to footage and original position of tracks. Basically, reprojection error below 0.3 means accurate reprojection, 0.3-3.0 means quite nice solving which still can be used. Values above 3 means some tracks should be tracked more accurate or that values for focal length or distortion coefficients were set incorrectly.

Refine option specifies which parameters should be refined during solve. Such kind of refining is useful when you aren't sure about some camera intrinsics and solver would try to find best parameter for that intrinsics. But you still have to know approximate initial values - it'll fail to find correct values if they were set completely incorrect initially.

Cleanup Panel

This panel contains single operator and it's settings. This operator cleans up bad tracks: tracks which aren't tracked long enough or which failed to reconstruct accurate. Threshold values can be specified from slides below the button. Also, several actions can be performed for bad tracks:

- They can be simply selected
- Bad segments of tracked sequence can be removed
- The whole tracks can be deleted

Clip Panel

This panel currently contains the single operator **Set as background** which sets currently editing clip as camera background for all visible 3D viewports. If there's no visible 3D viewports or clip editor is opened in full screen, nothing will happen.

Properties available in tracking mode

Grease Pencil Panel

It's a standard grease pencil panel where new grease pencil layers and frames can be controlled. There's one difference in behavior of grease pencil from other areas - when new layer is created "by-demand" (when making stroke without adding layer before this) default color for layer would be set to pink. It makes stroke easy to notice on all kinds of movies.

Objects Panel



Objects Panel in clip editor

This panel contains list of all objects which can be used for tracking, camera or object solving. By default there's only one object in this list which is used for camera solving. It can't be deleted and other objects can't be used for camera solving, all added objects are used for object tracking and solving only. These objects can be referenced from Follow Track and Object Solver constraints. Follow Track uses camera object by default.

New objects can be added using **+** and active object can be deleted by **-** button. Text entry at the bottom of this panel is used to rename active object.

If some tracks were added and tracked to wrong object, they can be copied to another object using Track » Copy Tracks and Track » Paste Tracks.

Use case for all kind of objects (used for camera and object tracking) is the same: track features, set camera data, solve motion. Camera data is sharing between all objects and refining of camera intrinsics happens when solving camera motion only.

Track Panel



Track Panel in clip editor

First of all, track name can be changed in this panel. Track names are used for linking tracking data to other areas like follow track constraint.

Next thing which can be controlled here is marker's enabled flag (using button with eye icon). If marker is disabled, it's position wouldn't be used neither by solver nor by constraints.

Button with lock at the right of button with eye means track is locked. Locked tracks means it can't be edited at all. This helps to prevent accidental changes to tracks which are "finished" (tracked accurate along the whole footage).

Next widget placed on this panel is called "Track Preview" and it displays content of pattern area. This helps to check how good tracking is happening (control there's no slides from original position) and also helps to move track back to needed position. Moving of track can happen directly from this widget by mouse slide.

If anchor is used (position on image which is tracking is different from position which is used for parenting) preview widget will display area around anchor position. Such configuration helps for masking some things when there's no good feature at position where mask corner should be placed. Details of this technique would be written later.

There's small area below the preview widget which can be used to enlarge vertical size of preview widget (area is highlighted by two horizontal lines).

Next setting is channels control. Tracking happens in grayscale space, so a high contrast between feature and background yields more accurate tracking. In such cases disabling some color channels can help.

The last thing is custom color and preset for it. This setting overrides default marker color used in clip editor and 3D viewport and it helps to distinguish different type of features (for example features on far plane or near plane and so). Color is also can be used for "grouping" tracks so the whole group of tracks can be selected by color using Select Grouped operator.

- **Marker Tip 1:** To use good points for tracking, use points in the middle of the footage timeline and track backwards and forwards from there. This will provide greater chance of the marker and point staying in the camera shot.

Camera Data Panel

This panel contains all settings of camera used for screening movie which is currently editing in clip editor.

First of all, predefined settings can be used here. New presets can be added or unused presets can be deleted. But such settings as distortion coefficients and principal point aren't included into presets and should be filled in even if camera presets were used.

- **Focal Length** is already self-described, it's a focal length with which movie was shoot. It can be set in millimeters and pixels. In most cases focal length is given in millimeters, but sometimes (for example in some tutorials in the Internet) it's given in pixels. In such cases it's possible to set it directly in units it's known in.
- **Sensor Width** is a width of CCD sensor in camera. This value can be found in camera specifications.
- **Pixel Aspect Ratio** is a pixel aspect of CCD sensor. This value can also be known from camera specifications, but can also be guessed. For example, you know that footage should be 1920x1080 but images itself are 1280x1080. In this case pixel aspect is:

$$1920 / 1280 = 1.5$$

- **Optical Center** is an optical center of lens used in camera. In most cases it's equals to image center, but it can be differ in some special cases. Check camera/lens specifications in such cases. To set optical center to center of image, there's **Center** button below sliders.
- **Undistortion K1, K2 and K3** is a coefficients used to compensate lens distortion happened on movie shooting. Currently this values can be tweaked by hand only (there's no calibration tools yet) using tools available in Distortion mode. Basically, just tweak K1 until solving would be most accurate for known focal length (but also take grid and grease pencil into account to prevent "impossible" distortion)

Display Panel

This panel contains all settings which controls things displayed in clip editor.

- **R, G, B** and **BW** buttons at the top of this panel are used to control color channels used for frame preview and to make the whole frame grayscale. It's needed because tracking algorithm works with grayscale image and it's not always obvious to see which channels disabled will increase contrast of feature point and reduce noise.
- **Pattern** can be used to disable displaying of rectangles which are correspond to pattern areas of tracks. In some cases it helps to make clip view more clear and check how good tracking is.
- **Search** can be used to disable displaying of rectangles which are correspond to search areas of tracks. In some cases it helps to make clip view more clear and check how good tracking is. Search areas for selected tracks only would be displayed.
- **Pyramid** makes the highest pyramid level be visible. What pyramid itself is would be described later in Tracking Settings panel section, but basically it helps to determine how much track is allowed to move from one frame to another.
- **Track Path** and **Length** controls displaying of path of tracks. So way in which tracks are moving can be visible looking at the only one frame. It helps to determine if track jumps from it's position or not.
- **Disabled Tracks** makes possible to hide all tracks which are disabled on current frame. This helps to make view more clear to control if tracking happens accurate enough.
- **Bundles** makes sense after solving movie clip and it works in the following way: solved position of each track gets projected back to movie clip and displayed as small point. Color of point depends on distance of projected coordinate and original coordinate: if they are close enough point would be green, otherwise it'll be red. This helps to find tracks which weren't solved nicely and need to be tweaked.
- **Track Names and Status** displays such information as track name and status of track (if it's keyframed, disabled, tracked or estimated). Names and status for selected tracks is displayed.
- **Compact Markers**. Way in which markers are displayed (black outline and yellow foreground color) makes tracks be visible on all kind of footages (both dark and light). But sometimes it can be annoying and this option will make displaying of marker in more compact manner - outline would be replaced by dashed black lines drawing on top of foreground, so markers areas would be 1px thick only.
- **Grease pencil** means if grease pencil strokes are allowed to be displayed and made.
- **Mute** changes displaying on movie frame itself with black square, It helps to find tracks which are tracked inaccurate or which weren't tracked at all.
- **Grid** (available in distortion mode only) displays grid which is originally orthographic but was affected by distortion model. This grid can be used for manual calibration - distorted lines of grids are equal to straight lines in the footage.
- **Manual Calibration** (available in distortion mode only) applies distortion model for grease pencil strokes. This option also helps to perform manual calibration. More detailed description of this process would be made later.
- **Stable** (available in reconstruction mode only). This option makes displaying frame be affected by 2D stabilization settings. It's only preview option which doesn't actually changes footage itself.
- **Lock to Selection** makes editor be displaying selected tracks on the same screen position along the whole footage during playback or tracking. This option helps to control tracking process and stop it when track is starting sliding off or when it jumped.
- **Display Aspect Ratio** changes aspect ratio for displaying only. It does not affect on tracking or solving process.

Tracking Settings Panel

Common options

This panel contains all settings for 2D tracking algorithms. Depending on which algorithm is used, different settings would be displayed, but there are also few common for all trackers settings:

Adjust Frames controls which patterns are getting tracking, if be more precise, pattern from which frame is getting tracked. Here's an example which should make things more clear.

Tracker algorithm receives two images inside search area and position of point to be tracked in first image. And tracker tries to find position of point from first image on second image.

Now, how tracking of sequence happens. Second image is always image created from frame at which position of marker isn't known (next tracking frame). But different first image can be send to tracker. Most commonly used combinations:

- Image created from frame on which track was keyframed. This configuration prevents sliding from original position (because position which corresponds most to the original pattern is returning by tracker), but it can lead to small jumps and can lead to failures when feature point is getting deformed due to camera motion (perspective transformation, for example). Such configuration is used if **Adjust Frames** is set to 0.
- Image created from current frame is sending as first image to the tracker. In this configuration pattern is tracking between two neighbor frames and it allows to deal with cases of high transformations of feature point but can lead to sliding from original position, so it should be controlled. Such configuration is used if **Adjust Frames** is set to 1.

If **Adjust Frames** is greater than 1, behavior of tracker would be like keyframes for tracks are creating every **Adjust Frames** frames and tracking between keyframed image and next image is used.

Speed can be used to control speed of sequence tracking. This option makes nothing with quality of tracking it's just helps to control if tracking happens accurate. In most of cases tracking happens much faster than realtime playing and it's difficult to notice when track began to slide off from position. In such cases **Speed** can be set to Double or Half to add some delay between tracking two frames, so slide off would be noticed earlier and tracking process can be cancelled to adjust positions of tracks.

Frames Limit controls how many frames can be tracked when Track Sequence operator is called. So, each Track Sequence operation would track maximum **Frames Limit** frames. This also helps to notice slide off of tracks and correct them.

Margin can be used to make tracks disabled when they are becoming too close to image boundary. This slider controls "too close" in pixels.

KLT tracker options

KLT tracker is an algorithm used by default. It allows to track most kinds of feature points and it's motion. It's using pyramid tracking which works in the following way. Algorithm tracks larger image than pattern first to find general direction of motion. Then it tracks a bit smaller image to refine position from first step and make final position more accurate. This continues several times. Number of steps of such tracking is equal to **Pyramid Level** option and we tell that on first step tracking happens for highest pyramid level. So Pyramid Level=1 is equal to pattern itself, and each next level doubles tracking image by 2.

Search area should be larger than highest pyramid level and "free space" between search area and highest pyramid level defines how much feature can be moved from one frame to another.

Default settings should work in most of general cases, but sometimes pyramid level should be changed. For example, when footage is blurry, adding extra pyramid levels helps to track them.

This algorithm can fail in situations when feature point is moving in one direction and texture around feature point is moving in another direction.

SAD tracker options

On each step SAD tracker reviews the whole search area and finds pattern on second image which is mostly like pattern which is getting tracking. This works pretty fast, but can fail in several cases. For example, when there're another feature point which looks like tracking feature point appears in search area. In this case SAD will lead to jump of track from one feature to another.

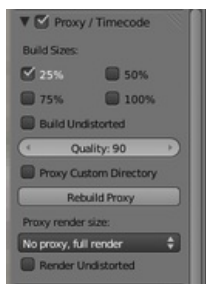
Correlation defines threshold value for correlation between two patterns which is still considering as successful tracking. 0 means there's no correlation at all, 1 means correlation is full.

There's one limitation: currently, it works for features 16x16 only.

Marker Panel

This panel contains numerical settings for marker position, pattern and search areas dimensions, offset of anchor point from pattern center. All sliders are self-explainable.

Proxy / Timecode Panel



Proxy / Timecode
Panel in clip editor

This panel contains options used for image proxies and timecodes for movies.

Proxy allows to display images with lower resolution in clip editor. This can be helpful in cases when tracking of 4K footage is happening on machine with small amount of RAM.

First four options are used to define which resolutions of proxy images should be built. Currently it's possible to build images 25%, 50%, 75% and 100% from original image size. Proxy size of 100% can be used for movies which contains broken frames which can't be decoded.

Build Undistorted means that proxy builder would also create images from undistorted original images for sizes set above. This helps to have faster playback of undistorted footage.

Generated proxy images are encoding using JPEG and quality of JPEG codec is controlled by **Quality** slider.

By default, all generated proxy images are storing to <path of original footage>/BL_proxy/<clip name> folder, but this location can be set by hand using **Proxy Custom Directory** option.

Rebuild Proxy will regenerate proxy images for all sizes set above and regenerate all timecodes which can be used later.

Use Timecode Index can (and better be used) for movie files. Basically, timecode makes frame search faster and more accurate. Depending on your camera and codec different timecodes can make better result.

Proxy Render Size defines which proxy image resolution is used for display. If **Render Undistorted** is set, then images created from undistorted frame would be used. If there's no generated proxies, render size is set to "No proxy, full render" and render undistorted is enabled, undistortion will happen automatically on frame draw.

Tools available in reconstruction mode



Proxy / 2D
Stabilization Panel
in clip editor

There's one extra panel which is available in reconstruction mode - 2D stabilization panel.

This panel is used to define data used for 2D stabilization of shot. Several options are available in this panel.

First of all, it's list of tracks used to compensate camera jumps, or location. It works in the following way: it gets tracks from list of tracks used for location stabilization and finds median point of all these tracks on first frame. On each other frame algorithm makes this point have the same position in screen coordinates by moving the whole frame. In some cases it's not needed to fully compensate camera jumps and **Location Influence** can be used in such cases.

Camera can also rotate a bit adding some tilt to the footage. There's **Stabilize Rotation** option to compensate this tilt. Extra single track is needed to set for this and it works in the following way. On first frame of movie, this track is getting connected with median point of tracks from list above and angle between horizon and this segment is keeping constant along the whole footage. Amount of rotation applying on the footage can be controlled by **Rotation Influence**.

If camera jumps a lot, it'll be noticeable black areas near image boundaries. To get rid of these black holes, there's **Autoscale** option which finds smallest scale, applying which on the footage all black holes near image boundaries would eliminate. There's option to control maximal scale factor (**Maximal Scale**) and amount of scale applying on the footage (**Scale Influence**)

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Motion_Tracking"

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Page status ([reviewing guidelines](#))

Partial page Text needs review and at least some img

Proposed fixes: none

Render engines

- Blender Internal
- [Cycles](#)

Rendering

Rendering is the final process of CG (short of post processing, of course) and is the phase in which a 2D image corresponding to your 3D scene is finally created. Rendering is a CPU-intensive process. You can render an image on your computer, or use a render farm which is a network of PC's that each work on a different section of the image or on different frames. This section provides a full explanation of the features in Blender related to the process of producing your image or animation.

After you have set up the materials, textures, and lighting, and the camera, you can begin rendering. It is unlikely that you will get it right on the first render, so be prepared to do many test renderings. This section describes the options and settings for the rendering process that will result in the desired image quality.

Blender has an internal render engine that it uses. This is a fast renderer, and can produce nice results if fine tuned. There are several other external renderers that can be loaded, which offer more advanced rendering tools.

We know that around the world, our users have PC's of widely varying power. Rendering is *the* process in CG that can chew up CPU and disk space like no tomorrow. Especially in corporate environments, it is easy to fill up terabyte servers by uploading ten hour-long DV tapes and doing some editing. So, there are lots of options try to shoehorn a big job into a small PC by providing you with multiple sets of options that chunk up the work as best we can, while still preserving image integrity.

This page discusses the main options found on the Render panel, and subsequent explain more.

Overview

The rendering of the current scene is performed by pressing the big Image button in the Render panel, or by pressing F12 (you can define how the rendered image is displayed on-screen in the [Render Output Options](#)). See also the [Render Window](#).

A movie is produced by pressing the big Animation button. The result of a rendering is kept in a buffer and shown in its own window. It can be saved by pressing F3 or via the File->Save Image menu using the output option in the Output panel. Animations are saved according to the format specified, usually as a series of frames in the output directory. See [Output Options](#) and [Animations](#).

The image is rendered according to the dimensions defined in the Dimensions Panel.

Workflow

In general, the process for rendering is:

1. Create all the objects in the scene
2. [Light the scene](#)
3. [Position the Camera](#)
4. Render a test image at 25% or so without oversampling or raytracing etc. so that it is very fast and does not slow you down
5. Set and Adjust the materials/textures and lighting
6. Iterate the above steps until satisfied at some level of quality
7. Render progressively higher-quality full-size images, making small refinements and using more compute time
8. Save your images

Distributed Render Farm

There are several levels of CPU allocation that you can use to decrease overall render time by applying more brainpower to the task.

First, if you have multi-core CPU, you can increase the number of threads, and Blender will use that number of CPUs to compute the render.

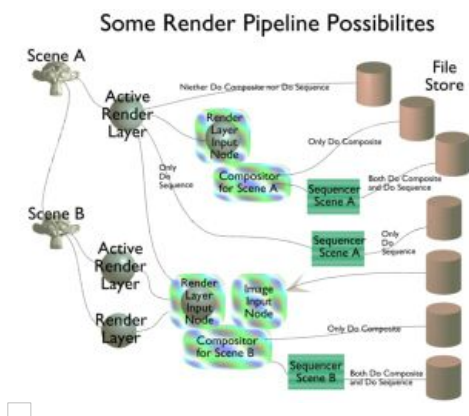
Second, if you have a local area network with available PC's, you can split the work up by frames. For example, if you want to render a 200 frame animation, and have 5 PC's of roughly equal processing power, you can allocate PC#1 to produce frames 1-40, PC#2 to frames 41-80, and so on. If one PC is slower than the others, simply allocate fewer frames to that PC. To do LAN renders, map the folder containing the .blend file (in which you should have packed your external data, like the textures, ...) as a shareable drive. Start

Blender on each PC and open the .blend file. Change the Start and End frame counts on that PC, but do not save the .blend file. Start Rendering. If you use relative paths for your output pathspec, the rendered frames will be placed on the host PC.

Third, you can do WAN rendering, which is where you email or fileshare or Verse-share the .blend file (with packed datas!) across the Internet, and use anyone's PC to perform some of the rendering. They would in turn email you the finished frames as they are done. If you have reliable friends, this is a way for you to work together.

Fourth, you can use a render farm service. These service, like BURP, is run by an organization. You email them your file, and then they distribute it out across their PC's for rendering. BURP is mentioned because it is free, and is a service that uses fellow Blender users PC's with a BOINC-type of background processing. Other services are paid subscription or pay-as-you-go services.

Render Workbench Integration



Blender has three independent rendering workbenches which flow the image processing in a pipeline from one to the other in order:

- Rendering Engine
- [Compositor](#)
- [Sequencer](#)

You can use each one of these independently, or in a linked workflow. For example, you can use the Sequencer by itself to do post processing on a video stream. You can use the Compositor by itself to perform some color adjustment on an image. You can render the scene, via the active Render Layer, and save that image directly, with the scene image computed in accordance with the active render layer, without using the Compositor or Sequencer. These possibilities are shown in the top part of the image to the right.

You can also link scenes and renders in Blender as shown, either directly or through intermediate file storage. Each scene can have multiple render layers, and each Render Layer is mixed inside the Compositor. The active render layer is the render layer that is displayed and checked active. If the displayed render layer is not checked active/enabled, then the next checked render layer in the list is used to compute the image. The image is displayed as the final render if Compositing and Sequencer are NOT enabled.

If Compositing is enabled, the render layers are fed into the Compositor. The noodles manipulate the image and send it to the Composite output, where it can be saved, or, if *Do Sequence* is on, it is sent to the Sequencer.

If Sequencer is enabled, the result from the compositor (if Do Composite is enabled) or the active Render layer (if Do Composite is not enabled) is fed into the Scene strip in the Sequencer. There, it is manipulated according to the VSE settings, and finally delivered as the image for that scene.

Things get a little more complicated when a .blend file has multiple scenes, for example Scene A and Scene B. In Scene B, if Compositing is enabled, the Render Layer node in Scene B's compositor can pull in a Render Layer from Scene A. Note that this image will not be the post-processed one. If you want to pull in the composited and/or sequenced result from Scene A, you will have to render Scene A out to a file using Scene A's compositor and/or sequencer, and then use the Image input node in Scene B's compositor to pull it in.

The bottom part of the possibilities graphic shows the ultimate blender: post-processed images and a dynamic component render layer from Scene A are mixed with two render layers from Scene B in the compositor, then sequenced and finally saved for your viewing enjoyment.

These examples are only a small part of the possibilities in using Blender. Please read on to learn about all the options, and then exercise your creativity in developing your own unique workflow.

The Render Settings Panel

The Render tab contains all of the options for the internal render engine, or an external one, if selected.

Render

Here you can activate the rendering process, by rendering a [Still Image](#) or an [Animation](#)

You can also select where the image is rendered to. These are described on the [Render Display](#) page.

Layers

The Layers menu contains options for rendering in [Layers](#) and [Passes](#)

Dimensions

This menu has settings for the size of the rendered images (see [Output Options](#)), and options for rendering sequences (see [Animations](#))).

Anti-Aliasing

[Antialiasing](#) is important for producing high quality renders that do not have "jaggies" or stair-stepped pixel artifacts.

Motion Blur

[Motion Blur](#) is an important effect in rendering moving images. It prevents the animation from appearing unrealistic and stuttery, as in stop-motion, where each frame is a perfect still image.

Shading

These are options for controlling what shading effects are calculated in the render. Deselecting them disables them.

- [Textures](#)
- [Shadows](#)
- [Subsurface Scattering](#)
- [Environment Maps](#)
- [Ray Tracing](#)
- [Color Management](#)

Uses a linear workflow when enabled

- [Alpha](#)

Set how transparent pixels are rendered

Output

Set where images are rendered to and what file type. See [Output Options](#).

Performance

Control the renderer performs in respect to the computer's memory and processor. See [Performance](#).

Post Processing

Control effects that are applied after the image has been rendered. If you are using the [Compositor](#) or [Sequencer](#), you can tell Blender to process those effects instead of directly rendering the scene.

Fields are used when [Rendering for Video](#)

[Dithering](#) is method of blurring pixels.

You can also enable [Edge Rendering](#) to create sketchy or toon-like effects.

Stamp

[Stamping](#) inserts text over the rendered images.

Bake

[Render Baking](#) is a process that creates texture files that hold desired rendered effects, like lighting, shadows, or color information. This is useful for working with real-time graphics that benefit from not having to calculate shading when not necessary.

Page status ([reviewing guidelines](#))

Text

Video is for old version

Proposed fixes: none

The Camera

A Camera is an object that provides a means of rendering images from Blender. They define which portions of a scene is visible at render time. Scenes can have multiples cameras, but *must* contain, at minimum, one camera.

Add a new camera

Mode: Object mode

Hotkey: ⇧ ShiftA to add new, F9 to change settings.

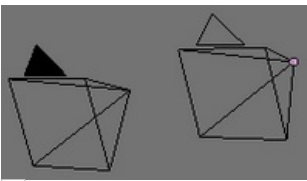
Menu: Add » Camera

In Object mode simply press ⇧ ShiftA and in the popup menu, choose Add » Camera.

Change active camera

Mode: Object mode

Hotkey: Ctrl0 NumPad



Active camera (left one).

The *active* camera is the camera that is currently used for rendering and camera view (0 NumPad). Select the camera you would like to make active and press Ctrl0 NumPad (by doing so, you also switch the view to camera view). In order to render, each scene **must** have a camera.

The active camera is the one with the filled “up” triangle on top seen in the 3D viewport. The left camera in (*Active camera (left one)*).



The active camera, as well as the layers, can be specific to a given view, or global (locked) to the whole scene – see [this part of the 3D view options page](#).

Camera Settings

Mode: Object mode

Panel: Camera



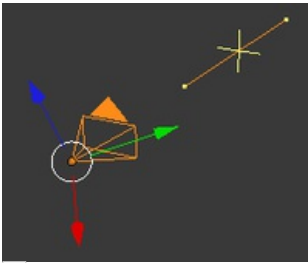
Camera panel.

Cameras are invisible in renders, so they don't have any material or texture settings. However, they do have Object and Editing setting panels available which are displayed when a camera is the selected (active!) object.

Lens

- Perspective/Orthographic

Toggles between Orthographic and Perspective modes for the camera. See [the 3D view page](#) for a more detailed description on Orthographic projection, as well as [Doc:2.5/Manual/Render/Perspective|on the next page]].



A camera with the clipping limits and focal point visible.

- Focal Length

Represents the lens focal length, represented in degrees or millimeters. When Orthographic mode is selected, the Focal Length setting changes to the Orthographic Scale setting. This setting determines the size of the camera's visible area.

- Panorama

Renders the scene with a cylindrical camera for panoramic renderings.

- Shift X/Y

Shifts the camera viewport. Note that most of the time, this setting should not be used to adjust the camera position, as the Shift setting is relative to the actual camera position, which will not be changed.

- Clipping Start/End

Sets the clipping limits. Only objects within the limits are rendered. If Limits is enabled, the clip bounds will be visible as two yellow dots on the camera line of sight (**C** on the *Camera* picture – the first is at camera's origin).

- Depth of Field object

When using [Depth of Field](#), the linked object will determine the focal point. Linking an object will deactivate the distance parameter.

- Distance

Distance to the focal point. It is shown as a yellow cross on the camera line of sight. Limits must be enabled to see the cross. It is used in combination with the [Defocus Compositing Node](#).

Display



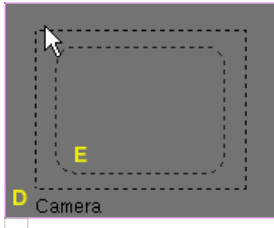
Camera Display panel.

- Limits

Toggles viewing of the limits on and off.

- Mist

Toggles viewing of the mist limits on and off. The limits are shown as two white dots on the camera line of sight (**A** and **B** on the *Camera* picture). The mist limits are set in the World panel, in the Mist section.



Camera View showing Title Safe border and camera name.

- Title Safe

When this is enabled, an extra dotted frame is drawn inside the camera viewport, delimiting the area considered as “safe” for important things, like titles (shown beside **E** in *Camera View*)

- Name

Toggle name display on and off (**D** on the *Camera View* picture).

- Size

Size of the camera icon in the 3D view. This setting has no effect on the render output of a camera, and is only a cosmetic setting. The camera icon can also be scaled using the standard Scale S transform key.

- Passepertout, Alpha

This mode darkens the area outside of the camera's field of view, based on the Alpha setting.

Note

The 3D View window contains settings similar to the camera, such as Orthographic/Perspective and Clip Start/Clip End. These settings have no effect on the camera rendering, and only change the view settings when *not* in Camera view. These settings are accessed through the View menu of the 3D View. See the [3D view options page](#) for more details.

Composition Guides

Composition Guides are available from the drop down menu, which can help when framing a shot. There are 8 types of guides available:

- Center

Adds lines dividing the frame in half vertically and horizontally.

- Center Diagonal

Adds lines connecting opposite corners.

- Thirds

Adds lines dividing the frame in thirds vertically and horizontally.

- Golden

Divides the width and height into Golden proportions (About 0.618 of the size from all sides of the frame).

- Golden Triangle A

Draws a diagonal line from the lower-left to upper-right corners, then adds perpendicular lines that pass through the top left and bottom right corners.

- Golden Triangle B

Same as A, but with the opposite corners.

- Harmonious Triangle A

Draws a diagonal line from the lower-left to upper-right corners, then lines from the top left and bottom right corners to 0.618 the lengths of the opposite side.

- Harmonious Triangle B

Same as A, but with the opposite corners.

Camera Navigation

Here you will find some handy ways to navigate and position your camera in your scene.

Note

Remember that the active “camera” might be any kind of object. So these actions can be used e.g. to position and aim a lamp...

Move active camera to view

Mode: Object mode

Hotkey: CtrlAlt0 NumPad


This feature allows you to position and orient the active camera to match your current view point.

Select a camera and then move around in 3D view to a desired position and direction for your camera. Now press CtrlAlt0 NumPad and your selected camera positions itself at your spot, and switches to camera view.

Camera View Positioning

By enabling Lock Camera to View in the View menu of the View Properties panel, while in camera view, you can navigate the 3d viewport as usual, while remaining in camera view. Controls are exactly the same as when normally moving in 3d.

Roll, Pan, Dolly, and Track

To perform these camera moves, the camera must first be *selected*, so that it becomes the active object (while viewing through it, you can RMB -click on the solid rectangular edges to select it). The following actions also assume that you are in camera view (0 NumPad)! Having done so, we can now manipulate the camera using the same commands that are used to manipulate any object:

Roll: Press R to enter object rotation mode. The default will be to rotate the camera in its local Z-axis (the axis orthogonal to the camera view) , which is the definition of a camera “roll”.

Vertical Pan or Pitch: This is just a rotation along the local X-axis. Press R to enter object rotation mode, then X twice (the first press selects the *global* axis – pressing the same letter a second time selects the *local* axis – this works with any axis, see the [axis locking page](#)).

Horizontal Pan or Yaw: This corresponds to a rotation around the camera’s local Y axis... Yes, that’s it, press R, and then twice Y!

Dolly: To dolly the camera, press G then MMB  (or twice Z).

Sideways Tracking: Press G and move the mouse (you can use twice X or Y to get pure-horizontal or pure-vertical sideways tracking).

Aiming the camera in Flymode

When you are in Camera view, the [fly mode](#) actually moves your active camera...

Page status ([reviewing guidelines](#))

Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Perspective in Render

When you press F12 and get your render, you see an image as seen through the camera's "perspective". Like how you can *view* your model in 3D View from the top, front, side, or user perspective, you can *render* your object from different perspectives. This perspective takes into account the lens size, type, and offset in giving you that picture. Each perspective uses a different number of vanishing points.

If you look at a 3D image of a cube, you will see three kinds of edges: vertical, horizontal, and depth. If all of the vertical edges are exactly parallel, there is no vanishing point for them. If however, they are not parallel, if you extended them by continuing them with a ruler, they would at some point intersect. That point is called the vanishing point.

For special purposes, different kinds of render cameras can be set up to give you different perspectives. For reasons discussed below, you may wish to limit the number of vanishing points, especially for architectural purposes. Architects and drafting people are responsible for rendering the object or building with true dimensions and true relative proportions.

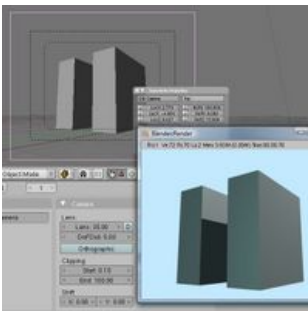
If you look at that example render, the building looks all sorts of distorted, like it had been made of mud and was collapsing. If you told a builder to build that, you would end up with a building that actually had leaning walls and rooms that were narrower at the top.

Way back in the old Greek days, when they started building tall columns, they built them thicker at the top than at the bottom, so that when viewed looking up, the two sides would look straight up and down. Then they even started narrowing the columns at the top to give the illusion that the building was taller and would look higher. During the Renaissance, the concept of using vanishing points in art evolved. Blender offers a few tricks of its own to let you do the same.

Note

To follow sections below you will need to know how to adjust [Camera Settings](#)

Three Point Rendering



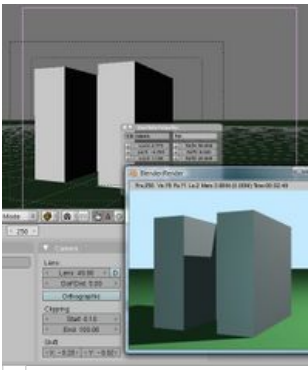
Normal Three Point Render

When looking at or rendering a picture of a high building from ground level off to one side, and aiming up, using the normal 35mm camera, you get 3 point perspective. If you laid a ruler along the vertical lines, you would see that they converge to a point above the building.

The horizontal lines are converging off to one side (the left in this example), and depth (receding) lines are converging to a different third point (somewhere off to the lower right in this example). Hence the name 3-point rendering - there are three vanishing points.

This is reality, and there is nothing wrong with that. When you next step outside and look at a tall building, this is what you actually see. However, your mind knows that the building is square, and can adjust your perception of the building so that you are not scared that the building is going to fall over.

Two Point Rendering



Two Point Vertical Render

Normal architectural rendering is called two point rendering; when vertical lines are parallel, and horizontals, if followed out to the side, converge on one point, and receding or depth lines converge to a second point.

Architects often like this Two-Point rendering, so that the sides of their buildings are completely vertical and don't appear to be falling inward. This is also quite nice for compositions and schematics, given that the lines of the paper you print on and the screen you view with are also straight.

Previously to get a 2-point perspective, you had to aim the camera level to the horizon, however this resulted in the top half of the building being cut off and the horizon being in the exact middle, which looks very boring. Architectural photographers use 'shift lenses' to solve this problem. Shift lenses shift the image to another place on the film.



Two Point Horizontal Render

This technique works well for high buildings as well as for normal sized objects.

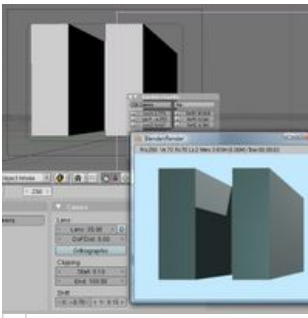
Most of the time, the two vanishing points are horizontal and depth lines, with the vertical lines parallel. However, some titles are done with the horizontal lines parallel, and the vertical and depth lines having the vanishing point. This dramatizes and exaggerates the massiveness and height of the title.

To get this effect, position the camera at ground level, centered, angle the camera upward, and shift the render passpartout down. In the example, the camera is rotated 30 degrees upward, at ground level with the title. A bright key light with a short falloff provides dramatic lighting that is bright in the middle and falls off toward the sides, further enhancing the depth.

To achieve 2-point rendering:

- Use a short wide angle lens camera, say with a Lens Size of 10 mm placed close to the building, or a long lens farther away from the building. These differences affect the depth of the building render, with longer lenses making the building appear thinner and less dramatic or distorted. The example uses a 40mm lens.
- Position the camera off to one side of the object, vertically halfway up the building to minimize distortion of the vertical building edges. You may alter this vertical (Z value) position to be slightly higher than ground level or higher than the top (if you want to see the top of the object or building). To show the front bottom corner of the building jutting out, raise up the camera.
- Angle the camera to be looking away from the building and directly level at the horizon - not pointed up or down (note the 20 degree Z angle in the example). This should make the vertical lines parallel. The more the camera looks at the object, the closer the vanishing point for the horizontal lines, and perceived depth will increase as that vanishing point gets closer as well.
- You may have to angle the camera slightly down (just 1 degree or so) so that vertical lines appear vertically up and down, both near and far. If the lines are curved, use a longer lens. With your 3D View set to Camera view, use the passpartout or pixels on your monitor to determine vertical.
- Move the camera toward/away from the object until it appears near a corner of the render and is the right size.
- Adjust the Shift: X and Y settings until your object is positioned properly.

One Point Rendering



One Point Render

One point rendering is where vertical and horizontal lines are parallel, and depth lines converge at one point. Architects really like these renders, since the front-facing faces are true and square, and the building recedes off into the distance so that it looks like it has some depth.

If the camera is placed at ground level, even with the bottom of the building, it really looks dramatic but orderly in a weird sort of way. Title graphics are sometimes rendered this way.

To get 1-point (1pt) renders

- To get more dramatic depth lines, use a short wide angle lens camera, say with a Lens Size of 10 mm, very close to the building. For a more normal appearance, stick with the 35mm lens.
- Position the camera off to one side of the object, slightly higher than the top (if you want to see the top of the object) or at ground level (the example image has the camera almost at ground level). If you position the camera *below* ground level, the bottom depth lines and horizontal lines will merge up (become congruent) for a *very dramatic* effect.
- Angle the camera looking straight back, perpendicular to the true face. Vertical lines should be parallel. Rotate the camera on the Z axis *slightly* toward the object until the horizontal edges are also parallel. Technically, you are correcting for parallax (just a casual line to drop on your girlfriend to impress her). The example has the camera rotated 0.5 degrees toward the object.
- Move the camera toward/away from the object until it appears at the proper size relative to your passpartout.
- Adjust the Shift: Y settings until the bottom of the passpartout (or title line if you want to show some approach ground in front of the building) is even with the bottom of the building. Adjust the X setting until the building is centered (or slightly offset from center for artistic appeal, or to show the parking lot next to it) as shown.

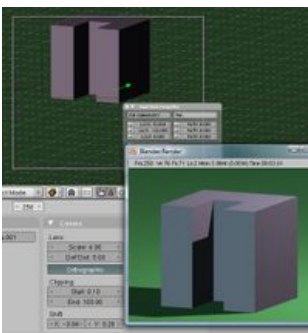
In the example screenshot, the Lens is 35, X is negative and Y is positive. The camera is off to the right of the object, even with the bottom of the building. If X & Y were zero, the building would have appeared off camera, in the upper left-hand corner of the passpartout.



Parallel Horizontal Edges

You can use the lines of the passpartout as a guide in rotating the camera to determine when the horizontal edges are parallel.

Orthographic Rendering



Orthographic Render

Zero point rendering is where vertical, horizontal AND depth lines are all parallel, and is commonly rendered at 45 degree, 30 degree, or 60 degree angles. With all of those sets of edges parallel to each other within that set, there are no vanishing points.

The example shows that same building rendered at 45 degrees from all angles. Note that the vertical lines are parallel to each other, the horizontals, and the depth lines are parallel to each other. From this, it is very easy to see that the left top edge of the building is the same length as the right top edge, and that the building is as deep as it is wide and high; if you measured the edges with a ruler, they

would all be the same.

Orthographic rendering gives a true mathematical render of the shape of the object. An Orthographic perspective is what you see in the User View of a 3D window (if View->Orthographic is turned on).

To get an Orthographic render:

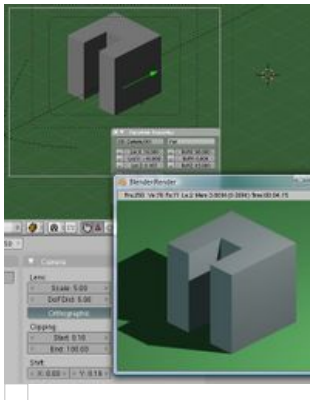
- Enable Orthographic in the Camera panel. This makes at least one face to be true to the camera.
- Point the camera at the object
- Position the camera or alter the Scale so the object is the desired size

With Orthographic cameras though, Lens size is irrelevant, since light rays do not converge to the camera from a field of view. They come in parallel, and so you can only Scale the camera size to take in more or less of that huge plane.

Note that Shift X & Y are zero, and that the camera is positioned perfectly off at a 45 degree angle to the object/building, and is rotated exactly 45 degrees to face the building. Thus, the near edge is aligned with the back edge (since the object is square).

Orthographic renders are usually made at 30, 45, or 60 degree angles to the object. Specific measurements are left to reader using triangle math.

Isometric Rendering



Isographic Render

While we are at it, we might as well cover Isometric rendering, which is a very specific type of orthographic render very often used in drafting and third-person computer games.

In Isometric renders, you want your depth lines and your horizontal lines to be at 30 degrees off horizontal, and your vertical lines to be, well, vertical. Some [complicated vector calculus in Wikipedia](#) gives us a convenient shortcut. To get Isometric Renders:

- Make your camera Orthographic
- Add a "Track To" constraint (Object F7 context, Constraints panel) to the camera for it to Track To the object (type the name in the Target OB: field), using To: -Z and Up Y.
- Position your camera so that it is 45 degrees in the XY plane from your object, and raised at a 30 degree angle. If your object is at XYZ (0,0,0), then your camera should be at (10, -10, 10), or for a view from the left side, (-10, -10, 10)
- Adjust the Scale of the camera (Editing F9 context, Camera panel) so that the object fits within the passpartout
- Adjust the Shift: Y value so that the object is centered in the render.

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Proposed fixes: none

Depth Of Field (DOF) Explained

Real world camera lenses and your eyeball transmit light through a lens (cornea) that bends the light, and an iris that limits the amount of light, to focus the image onto the film, CCD/CMOS sensor, or retina. Because of the interaction of the lens and iris, objects that are a certain distance away are in focus; objects in the foreground and background are out of focus. We call this distance their depth, or “Z” distance from the camera or eye.

Light comes to the lens (in the real world) at an angle; from some direction. What you see depends on your perspective; if you move closer, different angles of the scene are revealed. To make “flat” pictures, like an architectural drawing or plot, Blender can also make an orthographic rendering. So, there are two kinds of renderings, Perspective and Orthographic. Perspective simulates light coming in at an angle to the lens from the field of view, and Orthographic (disabled by default) simulates light coming straight in to an infinitely large backplane or flat retina.



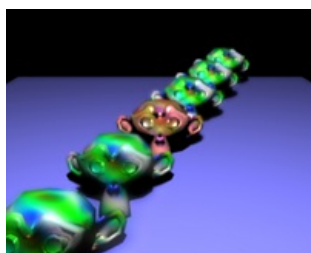
Depending on the diameter of the iris, there is a range (of distance) where objects are in focus. In cameras, the diameter of the iris is controlled by an “f-stop”. Said another way, there is *field of view* that you see left to right, up and down; your “picture”, if you will. At a certain range, or *depth* away from your eye, things are in focus. For example, at night, you may be able to focus your eye on objects that are 10 to 15 feet (3 to 5 meters) away. Anything closer than 10 or farther away than 15 is blurry. Your **depth of field** is thus 5 feet (2 m).

The larger the iris, the smaller the depth of field. This is why, during the day, you can focus on a range of things stretching out far from you. In film, there is a person whose job is to measure the distance from the camera to the actor’s nose, to ensure that the focus is set perfectly.

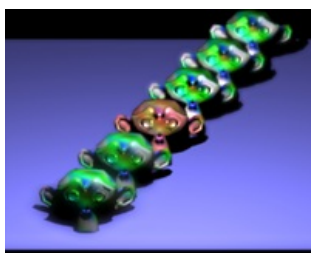
The more that an object is out of its depth (the perfect value for this depth is called *focal plane*), the blurrier it is. In fact, the depth of field is the range on both sides of the focal plane in which the blurriness of the objects is considered to be low enough to be imperceptible. In Blender, this distance is called the Dof Dist or “Depth of Field Distance” and is set in the Editing context (F9) for the camera. Alternatively, you can have the camera automatically stay focused on an object, by entering the name of the object in the Dof Ob field.

Field of View and Lens Size

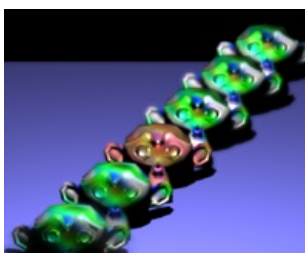
The field of view varies by the size of the lens. With cameras, a 35mm lens is kind of a standard size because the picture it takes mimics the size of the picture seen by the eye and pictures can be taken rather close. In Blender, use the Camera settings to change the size of the lens (35mm is the default). A longer lens taking a picture farther away has the same field of view, but has a different perspective of the view that many directors love because it “condenses” the scene and smooths a sweep, since it is farther away from the action:



35mm lens from 10 units away.



210mm lens from 60 units away at same



210mm at 50 units; repositioned to frame the

location/rotation.

view similar to the 35mm
shot.

Zooming in Blender

Zoom is the ability to expand a subset of the picture; we humans have no such ability. Well, I take that back; we do: we just get up off the couch and walk up closer to what we want to see (however, this is more like “traveling” than “zooming”). Blender allows you both actions: you can move the camera closer to or farther away from an object for a track (or “truck”) in/out, and/or change its lens size. You can automate these by assigning an Interpolated (lpo) curve to the object or to the camera, respectively.

Depth of Field in Computer Graphics

In computer graphics (CG), there is no physical lens or iris, so the depth-of-field (DOF) is infinite and all objects are always in focus. However, for artistic reasons, we want our main characters to be in focus, and everything else a little blurry, so that our audience does not focus on distracting things in the background. Also, it is easier to discern the main actors when they are in focus, and everything else isn't. So, we have to create an effect, or **Depth of Field Effect**, to composite our images and post-process them to achieve realistic-looking results.

Rendering and Saving Images

After you have adjusted your render settings, in regards to [Quality](#) and [Format](#), you will need to actually render the image rendering still images is fairly simple. [Rendering Animations](#) is a bit more complex and is covered in the next sections.

To render an image from the active camera, in the Render Panel, hit the big Image button. By default the 3D view is replaced with the UV/Image Editor and the render appears

Displaying Renders

Renders now are displayed in the Image Editor. You can set the way this is displayed to several different options in the Display drop down menu:

Keep UI

The image is rendered to the Image Editor, but the UI remains the same. You will need to open the Image Editor manually to see the render result.

New Window

A new floating window opens up displaying the render

Image Editor

The 3D view is replaced with the Image Editor, showing the render

Full Screen

The Image editor replaces the UI, showing the render

For each of these options, pressing Esc will close the render view and return to the previous view.

Saving

Rendered images can be saved by clicking on the Image menu and using the save options

Display Options

When a rendered image is displayed in the Image Editor, several new menu items become available.

Slot Menu

You can save successive renders into the render buffer by selecting a new slot before rendering. If an image has been rendered to a slot, it can be viewed by selecting that slot. Empty slots appear as blank grids in the image editor. Use the shortcut J to cycle through saved renders.

Render Layer

If you are using [Render Layers](#), use this menu to select which layer is displayed.

Render Pass

If you are using [Render Passes](#), use this menu to select which pass is displayed.

Image Painting

This icon enables or disables Image Painting.

Display Mode

The last four buttons set how the image is displayed.

RGB

Draw image as rendered, with out alpha channel.

RGBA

Replaces transparent pixels with background checker, denoting the alpha channel.

Alpha Channel

Displays a greyscale image. White areas are opaque, Black areas have a an alpha of 0.

Z Depth

Display the depth from the camera, from Clip Start to Clip End, as specified in the [Camera settings](#).

Curves Panel

The Curves Panel is available in the Properties Panel. You can use this to adjust the colors of the image.

Render Quality

Many factors go into the quality of the rendered image. Rendering a scene without changing any of the render settings is probably going to produce a rather unpleasant image. In previous chapters, you have learned how to model, shade, texture, and light scenes. Optimizing settings with respect to those areas will help to produce quality images, but there are some important settings that come into play before hitting the render button. These can directly affect the look of the rendered image.

Then next section covers render layers and render passes, both of which allow you to compose an image from several elements of a scene. In some cases it is necessary to render effects straight out of the renderer, rather than creating them in "post."

Color Management

One important aspect of 3D rendering that is often overlooked is color management. Without color management, or more commonly, linear rendering, render engines interpret scene lighting correctly, but display them incorrectly on your monitor. Blender simplifies this workflow, but it is important to know how the color space of a rendered image factors into your pipeline.

Anti-Aliasing

Anti-Aliasing removes jagged edges that appear in contrasting areas of color. This is a very important aspect of render quality. Without this render setting, images usually appear particularly CG and amateur.

Exposure

Exposure is, in physical terms, the length of time a camera's film or sensor is exposed to light. Longer exposure times create a brighter image. In CG, the recorded light values are offset to simulate longer or shorter exposures.

Depth of Field

Real cameras have a specific focal length. This is the distance from the lens where everything is in focus. Certain factors determine how much objects out of this range, or depth of field, are out of focus. By default, when rendering, all objects appear in perfect focus. Depth of Field (DOF) can create an unusual or appropriate sense of scale, depending how it is used.

Motion Blur

Cameras have a certain shutter speed, or the length of time the film is exposed to the image. Things that are in motion while the picture is taken will have some degree of blurring. Faster moving objects will appear more blurred than slower objects. This is an important effect in CG because, it is an artifact that we expect to see, and when it is missing, an image may not be believable.

Anti-Aliasing

A computer generated image is made up of pixels, these pixels can of course only be a single color. In the rendering process the rendering engine must therefore assign a single color to each pixel on the basis of what object is shown in that pixel. This often leads to poor results, especially at sharp boundaries, or where thin lines are present, and it is particularly evident for oblique lines.

To overcome this problem, which is known as *Aliasing*, it is possible to resort to an Anti-Aliasing technique. Basically, each pixel is 'oversampled', by rendering it as if it were 5 pixels or more, and assigning an 'average' color to the rendered pixel.

The buttons to control Anti-Aliasing, or OverSampling (OSA), are below the rendering button in the Render Panel (*Render Panel*).

Options

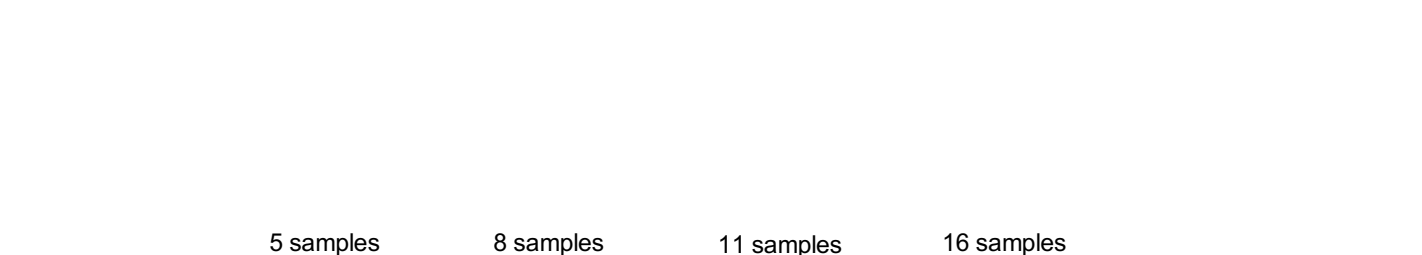
Anti-Aliasing check box
Enables oversampling

5 / 8 / 11 / 16
The number of samples to use. The values 5, 8, 11, 16 are pre-set numbers in specific sample patterns; a higher value produces better edges, but slows down the rendering.

By default, we use in Blender a fixed "Distributed Jitter" table. The samples within a pixel are distributed and jittered in a way that guarantees two characteristics:

1. Each sample has equal distances to its neighbor samples
2. The samples cover all sub-pixel positions equally, both horizontally and vertically

The images below show Blender sample patterns for 5, 8, 11 and 16 samples. To show that the distribution is equalized over multiple pixels, the neighbor pixel patterns were drawn as well. Note that each pixel has an identical pattern.



Full Sample

For every anti-aliasing sample, save the entire Render Layer results. This solves anti-aliasing issues with compositing.

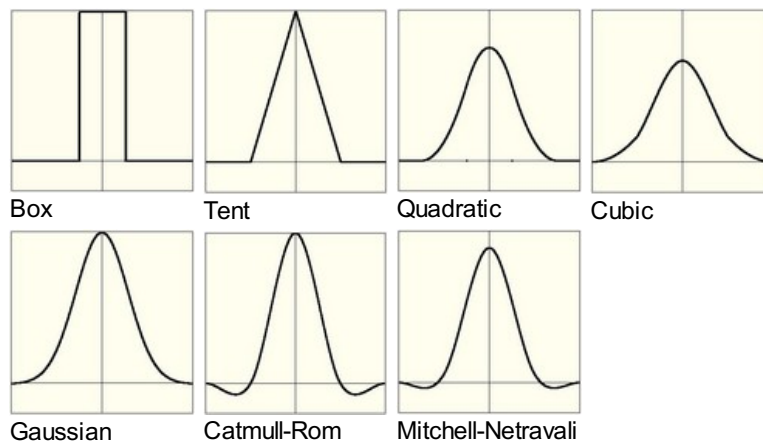
Filtering

When the samples have been rendered, we've got color and alpha information available per sample. It then is important to define how much each sample contributes to a pixel.

The simplest method is to average all samples and make that the pixel color. This is called using a "Box Filter". The disadvantage of this method is that it doesn't take into account that some samples are very close to the edge of a pixel, and therefore could influence the color of the neighbor pixel(s) as well.

Filter menu: Set The filter type to use to 'average' the samples: |Box |The original filter used in Blender, relatively low quality. For the Box Filter, you can see that only the samples within the pixel itself are added to the pixel's color. For the other filters, the formula ensures that a certain amount of the sample color gets distributed over the other pixels as well.

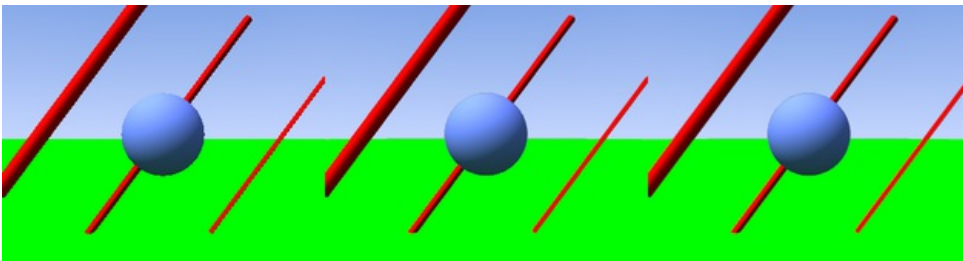
Box	A low quality box shaped curve (see above)
Tent	A simplistic filter that gives sharp results
Quadratic	A Quadratic curve
Cubic	A Cubic curve
Gauss	Gaussian distribution, the most blurry
Catmull-Rom	Catmull-Rom filter, gives the most sharpening
Mitchell-Netravali	Mitchell-Netravali, a good all around filter that gives reasonable sharpness



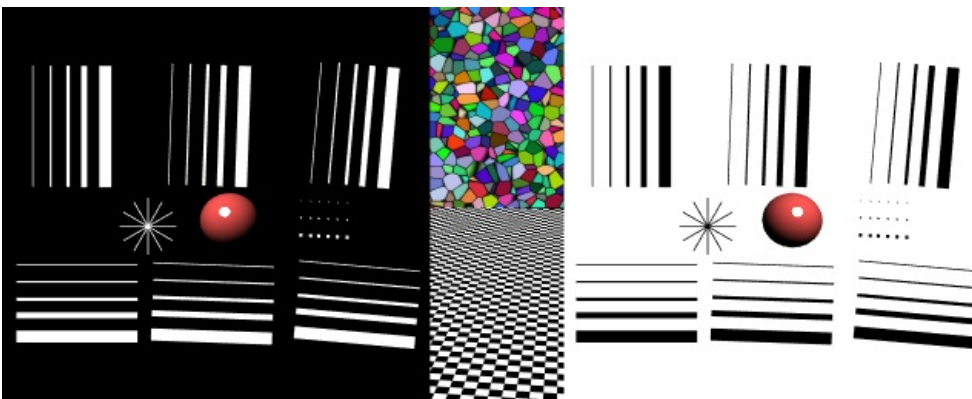
Filter Size

Making the filter size value smaller will squeeze the samples more into the center, and blur the image more. A larger filter size make the result sharper. Notice that the last two filters also have a negative part, this will give an extra sharpening result.

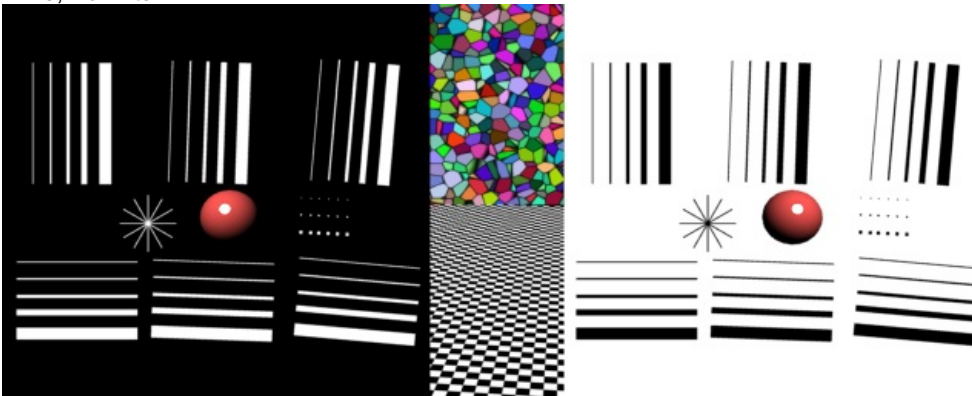
Examples



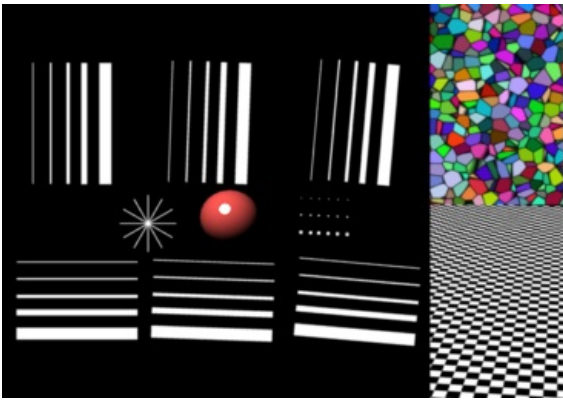
Rendering without AA (left) with AA=5 (center) and AA=8 (right).



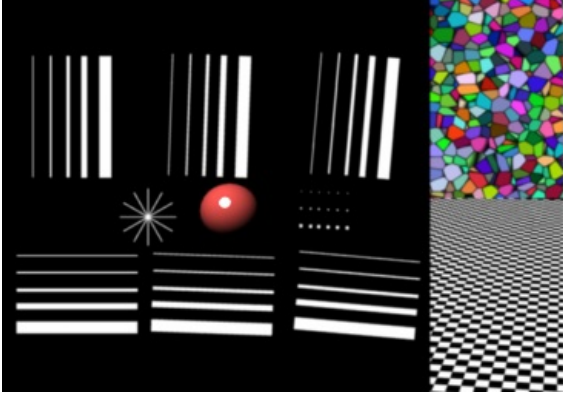
AA 8, Box filter



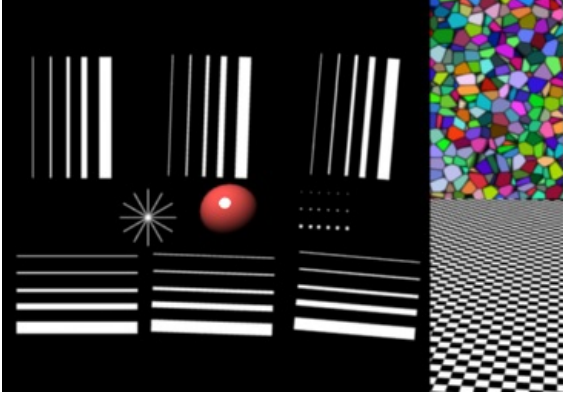
AA 8, Tent filter



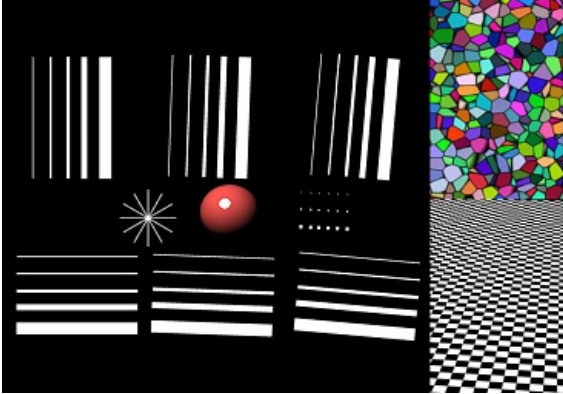
AA 8, Quadratic filter



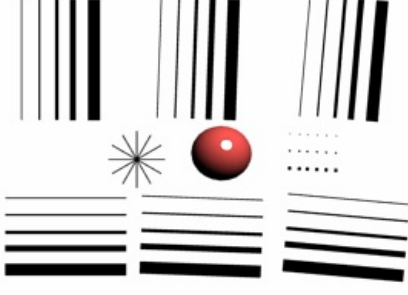
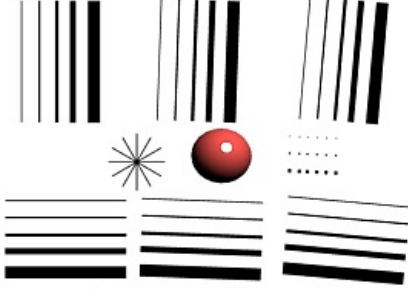
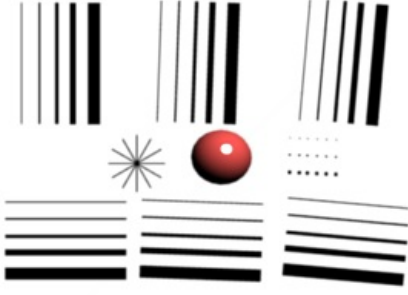
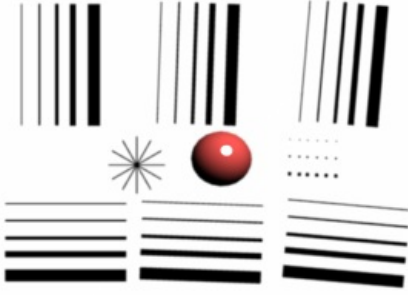
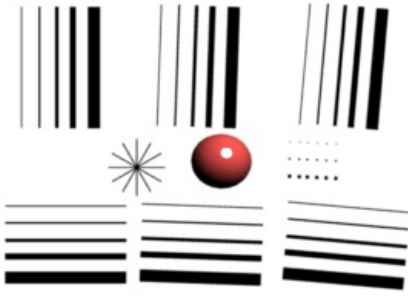
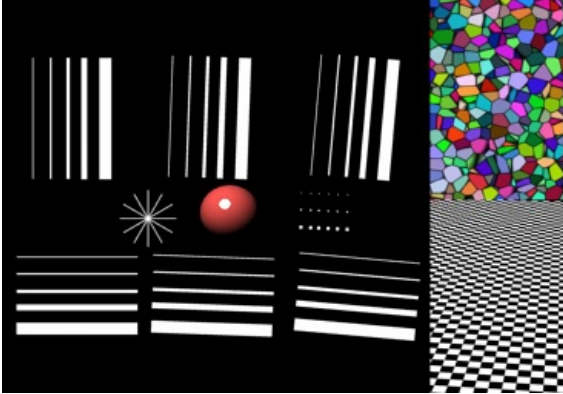
AA 8, Cubic filter



AA 8, Gaussian filter



AA 8, Catmull-Rom filter



Rendering Animations

While rendering stills will allow you to view and save the image from the render buffer when it's complete, animations are a series of images, or frames, and are automatically saved directly out to disk after being rendered.

After rendering the frames, you may need to edit the clips, or first use the Compositor to do green screen masking, matting, color correction, DOF, and so on to the images. That result is then fed to the Sequencer where the strips are cut and mixed and a final overlay is done.

Finally you can render out from the Sequencer and compress the frames into a playable movie clip

Workflow

Generally, you do a lot of intermediate renders of different frames in your animation to check for timing, lighting, placement, materials, and so on. At some point, you are ready to make a final render of the complete animation for publication.

There are two approaches you can use when making a movie, or animation, with or without sound. The approach you should use depends on the amount of CPU time you will need to render the movie (see [Render Performance](#)). You can render a "typical" frame at the desired resolution, and then multiply by the number of frames that will ultimately go into the movie, to arrive at an total render time.

If the total render time is an hour or more, you want to use the "Frame Sequence" approach. For example, if you are rendering a one-minute video clip for film, there will be (60 seconds per minute) * (24 frames per second) or 1440 frames per minute. If each frame takes 30 seconds to render, then you will be able to render two frames per minute, or need 720 minutes (12 hours) of render time.

Rendering takes all available CPU time; you should render overnight, when the computer is not needed, or set Blender to a low priority while rendering, and work on other things (be careful with the RAM space!).

The **Direct Approach**, is highly **not** recommended and not a standard practice, is where you set your output format to an AVI or MOV format, and click ANIM to render your scene directly out to a movie file. Blender creates one file that holds all the frames of your animation. You can then use Blender's VSE to add an audio track to the animation and render out to an MPEG format to complete your movie.

The **Frame Sequence** is a much more stable approach, where you set your output format to a still format (such as JPG, PNG or MultiLayer), and click ANIM to render your scene out to a set of images, where each image is the frame in the sequence.

Blender creates a file for each frame of the animation. You can then use Blender's compositor to perform any frame manipulation (post processing). You can then use Blender's VSE to load that final image sequence, add an audio track to the animation, and render out to an MPEG format to complete your movie. The Frame Sequence approach is a little more complicated and takes more disk space, but gives you more flexibility.

Here are some guidelines to help you choose an approach.

Direct Approach

- short segments with total render time < 1 hour
- stable power supply
- computer not needed for other uses

Frame Sequence Approach

- total render time > 1 hour
- post-production work needed
 - Color/lighting adjustment
 - Green screen / matte replacement
 - Layering/compositing
 - Multiple formats and sizes of ultimate product
- intermediate frames/adjustments needed for compression/codec
- precise timing (e.g. lip-sync to audio track) needed in parts
- may need to interrupt rendering to use the computer, and want to be able to resume rendering where you left off.

Frame Sequence Workflow

1. First prepare your animation.
2. In the Dimensions panel, choose the render size, Pixel Aspect Ratio, and the Range of Frames to use, as well as the frame rate, which should already be set.
3. In the Output panel setup your animation to be rendered out as a image, generally using a format that does not compromise any quality (I prefer PNG or MultiLayer because of their lossless nature).
4. Choose the output path and file type in the Output panel as well, for example "//render\my-anim-"

5. Confirm the range of your animation frame Start and End
6. Save your .blend file.
7. Press the big *Animation* button. Do a long task [like sleeping, playing a video game, or cleaning your driveway] while you wait for your computer to export the rendered frames.
8. Once the animation is finished, use your OS file explorer to navigate into the output folder (".\render in this example). You will see lots of images (.png or .exr, etc... depending on the format you chose to render) that have a sequence number attached to them ranging from 0000 to a max of 9999. These are your single frames.
9. In Blender, now go into the [video sequence editor](#).
10. Choose *Add Image* from the add menu. Select all the frames from your output folder that you want to include in your animation (Press A to Select All easily). They will be added as a strip to the sequence editor.
11. Now you can edit the strip and add effects or simply leave it like they are. You can add other strips, like an audio strip.
12. Scrub through the animation, checking that you have included all the frames.
13. In the Scene Render buttons, in the Post Processing panel, activate *Sequencer*.
14. In the Format panel, choose the container and codec you want (e.g. MPEG H.264) and configure it. The video codecs are described on the previous page: [Output Options](#)
15. Click the ANIMATION render button and Blender will render out the sequence editor output into your movie.

Why go through all this hassle? Well, first of all, if you render out single frames you can stop the render at any time by pressing Esc in the render window. You will not lose the frames you have already rendered, since they have been written out to individual files. You can always adjust the range you want to continue from where you left off.

You can edit the frames after wards and postprocess them. You can add neat effects in the sequence editor. You can render the same sequence into different resolutions (640x480, 320x240, etc) and use different codecs (to get different file sizes and quality) with almost no effort whatsoever.

Options

Output Panel

By default the animation is rendered in the directory specified in the Output Panel (*Animation location and extensions*). If an AVI format has been selected, then the name will be #####.#####.avi where the '#####' indicates the start and end frame of the animation, as 4 digit integers padded with zeros as necessary.

If an image format is chosen, on the other hand, a series of images named #####, ('#####' being the pertinent frame number) is created in the directory.

File Extensions

Adds the correct file extensions per file type to the output files

Overwrite

Overwrite existing files when rendering

Placeholders

Create empty placeholder frames while rendering

Post Processing Panel

Sequencer

Renders the output of the sequence editor, instead of the view from the 3D scene's active camera. If the sequence contains scene strips, these will also be rendered as part of the pipeline. If Do Composite is also enabled, the Scene strip will be the output of the Compositor.

Compositing

Renders the output from the Compositing noodle, and then pumps all images through the Composite node map, displaying the image fed to the Composite Output node.

Hints

Argh! My bratty sister turned off the PC right in the middle of rendering my movie!

Unless your animation is really simple, and you expect it to render in half an hour or less, it is always a good idea to render the animation as separate image frames in a lossless format (TGA, PNG, BMP) rather than as a movie file from the beginning. This allows you an easy recovery if there is a problem fails and you have to re-start the rendering, since the frames you have already rendered will still be in the Output directory. Just change the STArT frame number to the frame number where you want to pick up from, and click ANIM again.

I only need to re-render a few frames in the middle

It's also a good idea to render initially to a frame sequence, since if only a few frames have an error, you can make corrections and re-render just the affected frames. You can then make a movie out of the separate frames with Blender's sequence editor or with compositing nodes.

Only first frame renders, then Blender locks up

If you click ANIM and only the first frame renders, be sure the output file is not locked by the media player. In general, check the

console when rendering.

Unable to create Quicktime movie

CreateMovieFile error: -47

The Quicktime movie strip is in use (possibly in the VSE) and cannot be overwritten. If it is used in the VSE, delete the strip, or delete the file using your file explorer.

Render Baking

Baking, in general, is the act of pre-computing something in order to speed up some other process later down the line. Rendering from scratch takes a lot of time depending on the options you choose. Therefore, Blender allows you to "bake" some parts of the render ahead of time, for select objects. Then, when you press Render, the entire scene is rendered much faster, since the colors of those objects do not have to be recomputed.

Render baking creates 2D bitmap images of a mesh object's rendered surface. These images can be re-mapped onto the object using the object's UV coordinates. Baking is done for each individual mesh, and can only be done if that mesh has been UV-unwrapped. While it takes time to set up and perform, it saves render time. If you are rendering a long animation, the time spent baking can be much less than time spent rendering out each frame of a long animation.

Use Render Bake in intensive light/shadow solutions, such as AO or soft shadows from area lights. If you bake AO for the main objects, you will not have to enable it for the full render, saving render time.

Use Full Render or Textures to create an image texture; baked procedural textures can be used as a starting point for further texture painting. Use Normals to make a low-resolution mesh look like a high-resolution mesh. To do that, UV-unwrap a high-resolution, finely sculpted mesh and bake its normals. Save that normal map, and Mapping (texture settings) the UV of a similarly unwrapped low-resolution mesh. The low-resolution mesh will look just like the high-resolution, but will have much fewer faces/polygons.

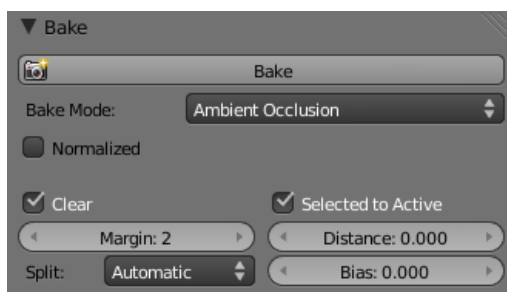
Advantages

- Can significantly reduce render times
- Texture painting made easier
- Reduced polygon count
- Repeated renders are made faster, multiplying the time savings

Disadvantages

- Object must be UV-unwrapped.
- If shadows are baked, lights and object cannot move with respect to each other.
- Large textures (eg 4096x4096) can be memory intensive, and be just as slow as the rendered solution.
- Human (labor) time must be spent unwrapping and baking and saving files and applying the textures to a channel.

Options



Ambient Occlusion

Bake Mode

Full Render

Bakes all materials, textures, and lighting except specular and SSS.

Ambient Occlusion

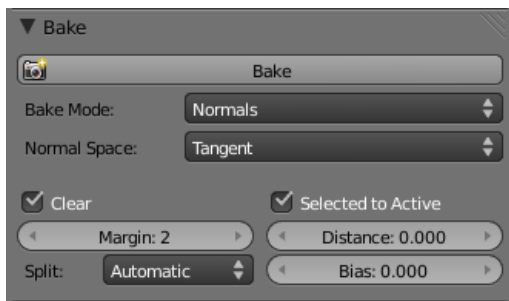
Bakes ambient occlusion as specified in the World panels. Ignores all lights in the scene.

Normalized

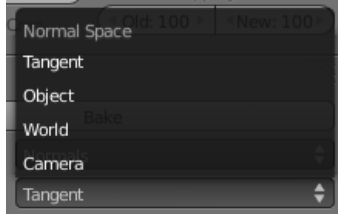
Normalize without using material's settings.

Shadow

Bakes shadows and lighting.



Normals



Normal Space

Normals

Bakes tangent and camera-space normals (amongst many others) to an RGB image.

Normal Space

Normals can be baked in different spaces:

Camera space

Default method.

World space

Normals in world coordinates, dependent on object transformation and deformation.

Object space

Normals in object coordinates, independent of object transformation, but dependent on deformation.

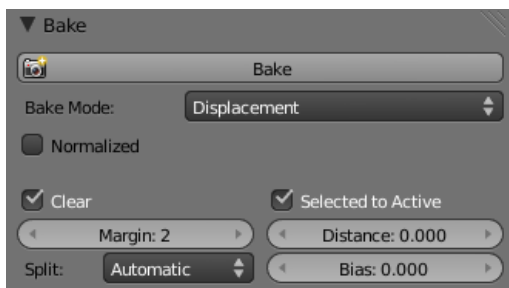
Tangent space

Normals in tangent space coordinates, independent of object transformation and deformation. This is the new default, and the right choice in most cases, since then the normal map can be used for animated objects too.

For materials the same spaces can be chosen as well, in the image texture options, next to the existing Normal Map setting. For correct results, the setting here should match the setting used for baking.

Textures

Bakes colors of materials and textures only, without shading.



Displacement

Displacement

Similar to baking normal maps, displacement maps can also be baked from a high-res object to an unwrapped low-res object, using the Selected to Active option.

Normalized

Normalize to the distance.

When using this in conjunction with a subsurf and displacement modifier within Blender, it's necessary to temporarily add a heavy subsurf modifier to the 'low res' model before baking. This means that if you then use a displacement modifier on top of the subsurf, the displacement will be correct, since it's stored as a relative difference to the subsurfed geometry, rather than the original base mesh (which can get distorted significantly by a subsurf). The higher the render level subsurf while baking, the more accurate the displacements will be. This technique may also be useful when saving the displacement map out for use in external renderers.

Emission

Bakes Emit, or the Glow color of a material.

Alpha

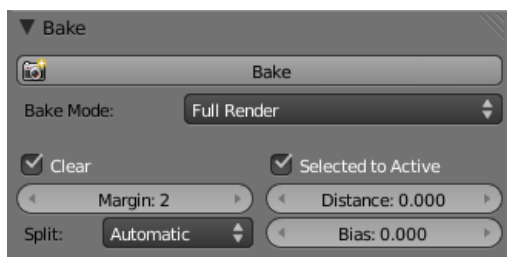
Bakes Alpha values, or transparency of a material.

Mirror Color and Intensity

Bakes Mirror color or intensity values.

Specular Color and Intensity

Bakes specular color or specular intensity values.



Full Render

Additional Options

Clear

If selected, clears the image to selected background color (default is black) before baking render.

Margin

Baked result is extended this many pixels beyond the border of each UV "island," to soften seams in the texture.

Split

Fixed

Slit quads predictably (0,1,2) (0,2,3).

Fixed alternate

Slit quads predictably (1,2,3) (1,3,0).

Automatic

Split quads to give the least distortion while baking.

Select to Active

Enable information from other objects to be baked onto the active object.

Distance

Controls how far a point on another object can be away from the point on the active object. Only needed for Selected to Active.

A typical use case is to make a detailed, high poly object, and then bake it's normals onto an object with a low polygon count. The resulting normal map can then be applied to make the low poly object look more detailed.

Bias

Bias towards further away from the object (in blender units)

Mesh Must be Visible in Render

If a mesh is not visible in regular render, for example because it is disabled for rendering in the Outliner or has the DupliVerts setting enabled, it cannot be baked to.

Workflow

1. In a 3D View window, select a mesh and enter UV/Face Select mode
2. [Unwrap the mesh object](#)
3. In a UV/Image Editor window, either create a new image or open an existing one. If your 3D view is in textured display mode, you should now see the image mapped to your mesh. Ensure that all faces are selected.
4. In the Bake panel at the bottom of the Render menu, bake your desired type of image (Full Render etcetera.)
5. When rendering is complete, Blender replaces the image with the Baked image.
6. Save the image.
7. Apply the image to the mesh as a UV texture. For displacement and normal maps, refer to [Bump and Normal Maps](#). For full and texture bakes, refer to [Textures](#).
8. Refine the image using the process described below, or embellish with [Texture Paint](#) or an external image editor.

Windows Users do AO first

If you are running Blender on a Windows operating system, you may have to first bake Ambient Occlusion before baking any other option. If you do not bake AO first, you may get the error message **"No Image to Bake To"** and will not be able to bake anything for that mesh and will have to restart Blender.

Introduction

In some situations we want to increase the render speed, access blender remotely to render something or build scripts that use blender command line.

One advantage of using command line is that we don't need the X server (in case of Linux) and as a consequence we can render remotely by SSH or telnet.

Note! Arguments are executed in the order they are given!

```
blender -b file.blend -a -x 1 -o //render
```

...Wont work, since the output and extension is set after blender is told to render.

Always position **-f** or **-a** as the last arguments.

Syntax

```
blender [-b <dir><file>] [-o <dir><file>] [-F <format>]
[-x [0|1]] [-t <threads>] [-S <name>] [-f <frame>]
[-s <frame> -e <frame> -a] [[-P <scriptname> [-- <parameter>]]]
```

Render options:

```
-b <dir><file>
    Render <file> that is inside the <dir> without load the UI
-P <filespec>
    Run the specified Python script (filename or Blender Text)
-S <name>
    Set scene <name>

-f <frame>
    Set frame <frame> to render and save it (Don't use together with -a)
-j <number>
    Render every x frames (jump frames by this number)

[-s <frame>] [-e <frame>] -a
    Set start frame (-s), end frame (-e) or both.
    The order is important and it's possible to use only the -s or the -e alone.

-o <dir><file>
    Set the render path and file name.
    Use // as <dir> to use the path render relative to the blend file.
    Use # in the filename to be replaced with the frame number
    eg: blender -b foobar.blend -o //render_# -F PNG -x 1

-F <format>
    Set the render format, Valid options are..
    TGA IRIS HAMX FTYPE JPEG MOVIE IRIZ RAWTGA
    VIRAW AVIJPEG PNG BMP FRAMESERVER
    (formats that can be compiled into blender, not available on all systems)
    HDR TIFF EXR MPEG AVICODEC QUICKTIME CINEON DPX

-x [0|1]
    Set option to add the file extension to the end of the file
    0 means no and 1 means yes.

-t <threads>
    Use amount of <threads> for rendering
```

Animation options:

(Used when pressing the play button, blender behaves like a movie player)

```
-a <options> <file(s)>
    Playback <file(s)>, only operates this way when -b is not used.

-p <sx><sy>
    Open with lower left corner at <sx>,<sy> (Doesn't work on win)
-m
    Read from disk (Don't buffer)
```

Window options:

```
-w
    Force opening with borders (default)
```

```
-W
    Force opening without borders (Linux/Unix Only)
-p <sx> <sy> <w> <h>
    Open with lower left corner at <sx>, <sy>
    and width and height <w>, <h>
```

Game Engine specific options:

```
-g fixedtime
    Run on 50 hertz without dropping frames
-g vertexarrays
    Use Vertex Arrays for rendering (usually faster)
-g noaudio
    No audio in Game Engine
-g nomipmap
    No Texture Mipmapping
-g linearmipmap
    Linear Texture Mipmapping instead of Nearest (default)
```

Misc options:

```
-d
    Turn debugging on
-noaudio
    Disable audio on systems that support audio
-h
    Print this help text
-Y
    Disable script links, use -Y to find out why its -y
-P <filename>
    Run the given Python script (filename or Blender Text)
-R
    Register .blend extension
-v
    Print Blender version and exit
```

Examples

Render a picture

```
# blender -b file.blend -o //file -F JPEG -x 1 -f 1
```

- **-b file.blend**
File .blend to render
- **-o //file**
Directory + Target image file
- **-F JPEG**
JPEG image format
- **-x 1**
Adds an extension .jpg to the file name
- **-f 1**
Render frame 1

Render a movie

```
# blender -b file.blend -x 1 -o //file -F MOVIE -s 003 -e 005 -a
```

- **-b file.blend**
File .blend to render
- **-x**
Adds an extension .avi to the movie
- **-o //images/file**

Directory + Target image file

- **-F MOVIE**

This saves a .AVI movie with low compression

- **-s 003 -e 005 -a**

Set start frame to 003 and end frame to 005. **Important:** You can use -s or -e, but if they're not in order, they'll not work!

Output Options

The first step in the rendering process is to determine and set the output options. This include, render size, frame rate, pixel aspect ratio, output location, and file type.

Dimensions

Resolution

The Dimensions section has settings for the size of the rendered images.

By default the dimensions SizeX and SizeY are 1920×1080 and can be changed by adjusting the X and Y fields. These buttons control the overall size of the image.

The Percentage slider will scale the currently set resolution to that value. This is useful for small test renders that are the same proportions as the final image.

Aspect Ratio

Just below are two more settings, AspX and AspY which control the shape of the pixels along the respective axis. By default it is 1:1 since computer screen pixels are square. If television shorts are being made, and since TV pixels are not square, you want to change this aspect ratio to match the destination video standard: PAL for Europe, and NTSC for the Americas.

See [Video Output](#) for details on pixel aspect ratio

Border

You can render just a portion of the view instead of rendering the entire frame. While in Camera View, enable Border and press ⇧ ShiftB, then drag a rectangle to define the area you want to render.

Note that this disables the Save Buffers option in Performance and Full Sample option in Anti-Aliasing

Enabling Crop will crop the rendered image to the Border size, instead of rendering a black region around it.

Frame Range

Set the Start and End frames for [Rendering Animations](#). Step controls the number of frames to advance by for each frame in the timeline.

Frame Rate

For an [Animation](#) the frame rate, or how many frames will be displayed per second, which, by default, is 24 frames per second, the standard for animation. Use 29.97 frames per second for USA television.

Time Remapping

Use to remap the length of an animation.

Presets

To make life easier the topmost menu provides some common presets (par = Pixel Aspect Ratio). You can add your own or remove one with the + and - buttons:


DVCPRO HD 1080p	1280x1080, 3:2par 24fps
DVCPRO HD 720p	960x720 4:3par 24fps
HDTV 1080p	1920×1080 square pixels 24fps
HDTV 720p	1280x720 square pixels 24fps
HDV 1080p	1440x1080 4:3par 23.98fps
HDV NTSC 1080p	1440x1080 4:3par 29.97fps
HDV PAL 1080p	1440x1080 4:3par 25fps
TV NTSC 16:9	720x480 4:3.3par 29.97fps
NTSC 4:3	720×480 10:11par. 29.97fps
PAL 16:9	720x576 16:11par 25fps
PAL 4:3	720x576 12:11par 25fps

These are just the presets; you can set any resolution you wish, subject to your PC's memory restrictions; see the Render page for ideas and techniques and tools for enabling huge render outputs.

Output Panel

This panel provides options for setting the location of rendered frames for animations, and the quality of the saved images.

File Locations

By default, each frame of an animation is saved in the /tmp directory. Change this or any field by ⇧ Shift LMB  clicking in the name field and entering a new name. If you use the // and do not save a new .blend file somewhere, Blender assumes the // to refer to the Blender install folder.

Clicking the folder icon to the right of the field turns a Blender window pane into a File Browser window. Using this window is very handy for scrolling through your hard disk and selecting a file or directory.

PathSpecs

The path specification for the location can be absolute *On Microsoft-Windows include a normal or mapped drive letter (e.g. "F:"), a breadcrumb notation (e.g. "/" and "/" and "/" (the blend file location). Forward slashes (Unix-style) or backslashes (Windows-style) are acceptable on either platform. If omitted, the file is saved in the current working directory blender is started from.*

File Type

Blender supports a wide mix of image formats. These formats are listed in alphabetical order they are (**bold** indicates a movie clip format):

The output format for for Animations **Animation** CtrlF12 is selected using the Format Panel. From here you can select many image or animation formats (*Image and animations formats.*). When rendering still images, you can select the file type after you render when you save the image.

There are many image formats out there for many different uses. A format stores an image in a *lossless* or lossy format; with lossy formats you suffer some image degradation but save disk space because the image is saved using fewer bytes. A lossless format preserves the image exactly, pixel for pixel. You can break formats down into *static* images and movie *clips*.

Within either category there are standards (static formats and clip codecs) which may be proprietary standards (developed and controlled by one company), or open standards (which are community or consortium-controlled). Open standards generally outlive any one particular company and will always be royalty-free and freely obtained by the viewer. Proprietary formats may only work with a specific video card, or while the codec may be free, the viewer may cost.

Compression

Some formats can compress the image to use less disk space. This compression might be lossless (PNG, ...) or lossy (Jpeg, ...). Lossy formats don't store individual pixel information, thus reducing image quality. All the other formats are more or less equivalent, each having advantages and disadvantages. Make your compression selection using the button or field located beneath the format selector. For example, if Jpeg is selected, you can specify a compression level (Quality:90 by default). Higher quality takes more disk space, but results in a better looking picture with less compression encoding artifacts.

The default image type is Targa, but, since the image is stored in a buffer and then saved, it is possible to change the image file type after the rendering and before saving using this menu. (**attention:** this is only valid for static images, not when rendering animations!).

Channels

Blender renders color (RGB) images, but Black and White (BW) and color with Alpha Channel (RGBA) are also possible. Beware, unless the Extensions button of the Output pannel is set, Blender does *not* automatically add the extension to files, hence any .tga or .png extension must be explicitly written in the File Save window.

OpenEXR and **OpenEXR Multilayer** formats are the only formats that store Z-depth buffer information. **OpenEXR Multilayer** is the only format that stores Render Layer and Render Passes as layers that can then be composited in post-production.

Image Formats

BMP	Bit-Mapped Paint lossless format used by early paint programs.
Iris	The standard Silicon Graphics Inc (SGI) format used on those spanking Unix OS machines. Portable Network Graphics, a standard meant to replace old GIF inasmuch as it is lossless, but supports full true colour images. Supports Alpha channel.
PNG	Enable the RGBA button to save the Alpha channel.
Jpeg	Joint Picture Expert Group (name of the consortium which defined it), an open format that supports very good compression with little loss of quality. Only saves RGB value. Re-saving images results in more and more compression and loss of quality.
Jpeg 2000	Uses the Jpeg 2000 codec.
	Truevision Advanced Raster Graphics Adapter is a simple raster graphics format established in 1984 and used by the

TARGA and Targa raw	original IBM PC's. Supports Alpha Channel. Enable the RGBA button to save the Alpha channel.
Cineon	format produced by a Kodak Cineon camera and used in high-end graphics software and more directed toward digital film.
DPX	Digital Moving-Picture eXchange format; an open professional format (close to Cineon) that also contains meta-information about the picture; 16-bit uncompressed bitmap (huge file size). Used in preservation.
MultiLayer	an OpenEXR format that supports storing multiple layers of images together in one file. Each layer stores a renderpass, such as shadow, specular, color, etc. You can specify the encoding used to save the MultiLayer file using the codec selector (ZIP (lossless) is shown and used by default).
	an open and non-proprietary extended and highly dynamic range (HDR) image format, saving both Alpha and Z-depth buffer information.
OpenEXR	<ul style="list-style-type: none"> Enable the <i>Half</i> button to use 16-bit format; otherwise 32-bit floating point precision color depth will be used Enable the <i>Zbuf</i> button to save the Z-buffer (distance from camera) info Choose a compression/decompression <i>CODEC</i> (ZIP by default) to save disk space. Enable the <i>RGBA</i> button to save the Alpha channel. Because OpenEXR is so new and previews are generally not supported by Operating Systems, enable <i>Preview</i> to save a JPG image along with the EXR image so you can quickly and easily see what the basic image looks like.
Radiance HDR	a High Dynamic Range image format that can store images in floating point (with light brighter than 1.0) - 32bits per channel.
TIFF	Often used for teletype and facsimile (FAX) images
Frame Server	This is an alternative output method that allows blender to serve frames over a network, useful for using external video encoders where the frames would not fit uncompressed on disk documentation

VSE Rendering

Rendering to an Image Sequence

In many cases, cutting and re-arranging (editing) a codec-encoded video strip will give you fits, because of the encoding algorithm that is used internally to reconstruct each image gets 'off' by a frame or two or three. To work directly on the 'raw' frame set, a very common technique is to import your video as a strip and render it out to series of individual frames, where each frame is stored in its own image file (JPG most commonly).

To do so, Add->Movie and load your original video. Set your Format SizeX and SizeY (either to match the original, or different if you want to distort or upscale/downscale the video), set image type to JPEG, adjust your Quality settings, and in the Anim panel set your End: to the number of actual frames in the video strip. Click ANIMATION and a series of number files will be output to the top filespec in the Output panel.

You can now delete the video strip, and Add->Image instead, and right click on the directory name to pull in all of the images, in sequence, that are within that directory. Now, when you cut at frame 4321, for example, the next frame of the second strip will *really* start with frame 4322.

Rendering to Video

Ridiculously easy (when you learned where the buttons are):

1. Add the sequence of images as described above
2. Set your Output file path and name to wherever you want to save the movie file (e.g. C:\My Documents\MyMovie) in the upper output box of the render buttons.
3. Change your Format to a movie file format (AVI, MOV, FFMPEG) and CODEC
4. Set your framerate to match whatever framerate the sequence is to be played back in. Under the Anim/Playback buttons.
5. Set your ANIM End: to the number of images in the sequence, and
6. ANIM

The single movie file is created and saved; the name is what you specified but with the starting frame and ending frame numbers appended (e.g. MyMovie0000-0250.avi)

Text need to fill in the blanks to the Video Files section

Proposed fixes: [X](#)

Preparing your work for video

Once you have mastered the trick of animation you will surely start to produce wonderful animations, encoded with your favourite codecs, and possibly you'll share them on the Internet with the rest of the community.

Sooner or later you will be struck by the desire of building an animation for Television, or maybe burning your own DVDs. To spare you some disappointment, here are some tips specifically targeted at Video preparation. The first and principal one is to remember the double dashed white lines in the camera view!

If you render for PC then the whole rendered image, which lies within the *outer* dashed rectangle will be shown. For Television, some lines and some part of the lines will be lost due to the mechanics of the electron beam scanning in your TV's cathode ray tube. You are guaranteed that what is within the *inner* dashed rectangle in camera view will be visible on the screen. Everything within the two rectangles may or may not be visible, depending on the given TV set that your audience watches the video on.

The rendering size is strictly dictated by the TV standard. Blender has four pre-set settings for your convenience:

- PAL 720x576 pixels at 54:51 aspect ratio.
- NTSC 720x480 pixels at 10:11 aspect ratio.
- PAL 16:9 720x576 at 64:45 aspect ratio, for 16:9 widescreen TV renderings.
- HD 1920 x 1080 pixels at 1:1 aspect, that operates in a downsampled mode of 720 horizontal scan lines interlaced.

If you render your animation at 1600x1200 resolution, and then burn a DVD, your image will not be clearer or crisper on the TV; in fact the DVD burning software will have had to downsize your images to fit the resolutions shown above, and you will have wasted about 4x disk space and render time.

Pixel Aspect Ratio

Older TV screens do *not* have the square pixels which Computer monitors have; their pixels are somewhat rectangular, so it is necessary to generate *pre-distorted* images which will look bad on a computer but which will display nicely on a TV set. It is important that you use the correct pixel aspect ratio when rendering to prevent re-sampling, resulting in lowered image quality.

Colour Saturation

Most video tapes and video signals are not based on the RGB model but on the YCrCb model: more precisely, the YUV in Europe (PAL), and the YIQ in the USA (NTSC), this latter being quite similar to the former. Hence some knowledge of this is necessary too.

The YCrCb model sends information as 'Luminance', or intensity (Y) and two 'Chrominance' signals, red and blue (Cr and Cb). Actually a Black and White TV set shows only luminance, while colour TV sets reconstruct colour from Chrominances (and from luminance). The construction of the YCrCb values from the RGB ones takes two steps (the constants *in italics* depend on the system: PAL or NTSC):

First, the Gamma correction (*g* varies: 2.2 for NTSC, 2.8 for PAL):

- $R' = R^{1/g} \cdot G' = G^{1/g}$
- $B' = B^{1/g}$

Then, the conversion itself:

- $Y = 0.299R' + 0.587G' + 0.114B'$
- $Cr = a_1(R' - Y) + b_1(B' - Y)$
- $Cb = a_2(R' - Y) + b_2(B' - Y)$

Whereas a standard 24 bit RGB picture has 8 bits for each channel, to keep bandwidth down, and considering that the human eye is more sensitive to luminance than to chrominance, the luminance signal is sent with more bits than the two chrominance signals. This bit-expansion results in a smaller dynamic of colours, in Video, than that which you are used to on Monitors. You hence have to keep in mind not all colours can be correctly displayed.

A Rule of thumb is to keep the colours as 'greyish' or 'unsaturated' as possible, this can be roughly converted in keeping the dynamics of your colours within 80% of one another. In other words, the difference between the highest RGB value and the lowest RGB value should not exceed 0.8 ([0-1] range) or 200 ([0-255] range).

This is not strict, something more than 0.8 is acceptable, but an RGB display with a color contrast that ranges from 0.0 to 1.0 will appear to be very ugly (over-saturated) on video, while appearing bright and dynamic on a computer monitor.

Rendering to fields

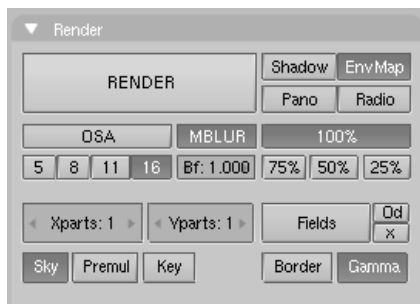
The TV standards prescribe that there should be 25 frames per second (PAL) or 30 frames per second (NTSC). Since the phosphorous of the screen does not maintain luminosity for very long, this could produce a noticeable flickering.

To minimize this TVs do not represent frames as a Computer does 'progressive' mode), but rather represents half-frames, or *fields* at a double refresh rate, hence 50 half frames per second on PAL and 60 half frames per second on NTSC. This was originally bound to the frequency of power lines in Europe (50Hz) and the US (60Hz).

In particular fields are "interlaced" in the sense that one field presents all the even lines of the complete frame and the subsequent field the odd ones.

Since there is a non-negligible time difference between each field (1/50 or 1/60 of a second) merely rendering a frame the usual way and splitting it into two half frames does not work. A noticeable jitter of the edges of moving objects would be present.

Options



Field Rendering setup.

- Fields

Enable field rendering. When the Fields button in the Render Panel is pressed (*Field Rendering setup.*), Blender prepares each frame in two passes. On the first it renders only the even lines, then it *advances in time by half a time step* and renders all the odd lines.

This produces odd results on a PC screen (*Field Rendering result.*)

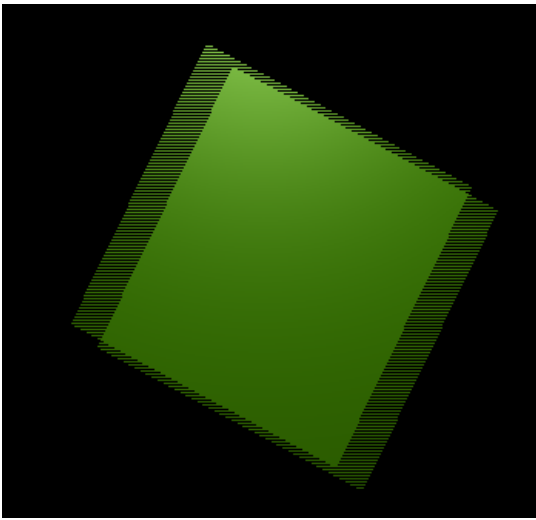
but will show correctly on a TV set.

- Upper First / Lower First

Toggles between rendering the even and odd frames first.

- Still

Disables the half-frame time step between fields (x).



Field Rendering result.

Setting up the correct field order

Blender's default setting is to produce Even fields *before* Odd fields, this complies with European PAL standards. Odd fields are scanned first on NTSC.

Of course, if you make the wrong selection things are even worse than if no Field rendering at all was used!

If you are really confused, a simple trick to determine the correct field order is to render a short test animation of a white square moving from left to right on a black background. Prepare one version with odd field order and another with even field order, and look at them on a television screen. The one with the right field order will look smooth and the other one horrible. Doing this simple test will save you *hours* of wasted rendering time...

Fields and Composite Nodes

Nodes are currently not field-aware. This is partly due to the fact that in fields, too much information is missing to do good neighborhood operations (blur, vector blur etc.). The solution is to render your animation at double frame rate without fields and do the interlacing of the footage afterwards.

Video Files

These formats are primarily used for compressing rendered sequences into a playable movie.

A Codec is a little routine that compresses the video so that it will fit on a DVD, or be able to be streamed out over the internet, over a cable, or just be a reasonable file size. Codecs compress the channels of a video down to save space and enable continuous playback. *Lossy* codecs make smaller files at the expense of image quality. Some codecs, like H.264, are great for larger images. Codecs are used to encode and decode the movie, and so must be present on both the encoding machine (Blender) and the target machine. The results of the encoding are store in a container file.

Blender knows two kinds of container files:

- Audio Video Interlace (a .avi extension) and
- QuickTime (a .mov extension).

When AVI Codec is selected, Blender will popup a little Codec selector window, listing the codecs that are registered on your machine. Each Codec has unique configuration settings. Consult the documentation on the codec (supplied by the company that wrote it) for more information.

When Quicktime is selected, the codecs on your machine will pop-up and allow you to pick which one you want to use. You may have to have purchased Quicktime Pro to use this.

There are dozens, if not hundreds, of codecs, including XviD, H.264, DivX, Microsoft, and so on. Each has advantages and disadvantages and compatibility with different players on different operating systems.

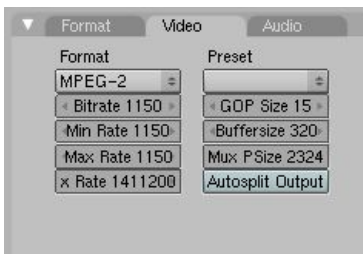
Most codecs can only compress the RGB or YUV color space, but some support the Alpha channel as well. Codecs that support RGBA include:

- animation (quicktime)

- PNG *TIFF *Pixlet - not lossless, and may be only available on Apple Mac.
- [\[Lagarith Lossless Video Codec\]](#)

AVI Codec	AVI codec compression. Available codecs are operating system dependent. When an AVI codec is initially chosen, the codec dialog is automatically launched. The codec can be changed directly using the Set Codec button which appears (<i>AVI Codec settings</i>).
AVI Jpeg	AVI but with Jpeg compression. Lossy, smaller files but not as small as you can get with a Codec compression algorithm. Jpeg compression is also the one used in the DV format used in the digital camcorders.
AVI Raw	Audio-Video Interlaced (AVI) uncompressed frames.
Frameserver	Blender puts out frames upon request as part of a render farm. The port number is specified in the OpenGL User Preferences panel.
H.264	Encodes movies with the H.264 codec. See Advanced Encoding
MPEG	Encodes movies with the MPEG codec. See Advanced Encoding
Ogg Theora	Encodes movies with the Theora codec as Ogg files. See Advanced Encoding
QuickTime	Apple's Quicktime .mov file. The Quicktime codec dialog is available when this codec is installed and this format is initially chosen. See Quicktime Encoding
	Blender can read GIF files on Windows and Mac platforms with [QuickTime] installed. The GIF capabilities (as well as flattened PSD, flattened PDF on Mac, and others) come along with QuickTime.
Xvid	Encodes movies with the Xvid codec. See Advanced Encoding

Advanced Encoding



If the H.264, MPEG, Ogg Theora, or Xvid codecs are chosen, an Encoding panel becomes available. This has settings for encoding these file types, and other formats using FFMPEG.

FFMPEG, short for Fast Forward Moving Pictures Expert Group, is a collection of free and open source software libraries that can record, convert and stream digital audio and video in numerous formats. It includes libavcodec, an audio/video codec library used by several other projects, and libavformat, an audio/video container mux and demux library.

Video Settings

Here you choose which video codec you want to use, and compression settings. With all of these compression choices, there is a tradeoff between filesize, compatibility across platforms, and playback quality.

You can use the presets, DV, SVCD, DVD, etc. which choose optimum settings for you for that type of output, or you can manually select the format (MPEG-1, MPEG-2, MPEG-4, AVI, Quicktime (if installed), DV, H.264, or Xvid (if installed)). You must have the proper codec installed on your computer for Blender to be able to call it and use it to compress the video stream.

Video Formats:

MPEG-1	...
MPEG-2	...
MPEG-4	...
AVI	...
Quicktime	...
DV	...
H.264	...
Xvid	...
Ogg	...
Matroska	...
Flash	...
Wav	...
Mp3	...

Video Codecs:

None	...
MPEG-1	...
MPEG-2	...
MPEG-4(DivX)	...
HuffYUV	...
DV	...
H.264	...
Xvid	...
Theora	...
Flash Video	...
FFmpeg video codec #1	...

Bitrate

..
Rate
...
Minimum
...
Maximum
...
Buffer
...

GOP Size

...

Autosplit Output

If your video is HUGE and exceeds 2Gig, enable Autosplit Output. The main control over output filesize is the GOP, or keyframe interlace. A higher number generally leads to a smaller file, but needs a higher-powered device to replay it.

Mux

...
Rate
...
Packet Size
...

Standards

Codecs cannot encode off-the-wall video sizes, so stick to the XY sizes used in the presets for standard TV sizes.

Audio Settings

Audio is encoded using the codec you choose.

Audio Codecs

MP2	...
MP3	...
AC3	...
AAC	...
Vorbis	...
FLAC	...
PCM	...

Bitrate

For each codec, you can control the bitrate (quality) of the sound in the movie. This example shows MP3 encoding at 128kbps. Higher bitrates are bigger files that stream worse but sound better. Stick to powers of 2 for compatibility.

Samplerate

Samplerate controls the number of samples per second of the audio. The default, 44100, is standard for many file types, including CD audio, and produces a high quality sound.

Volume

Set the output volume of the audio.

Tips

Choosing which format to use depends on what you are going to do with the image.

For still images, If you are going to

- email it to your friends, use **JPG**
- combine it with other images in post processing and simple color/alpha composition, use **PNG**
- use nodes to simulate depth of field and blurring, use **EXR**
- composite using Render Passes, such as the Vector pass, use **Multilayer**.

If you are animating a movie and are not going to do any post-processing or special effects on it, use either **AVI-JPEG** or **AVI Codec** and choose the XviD open codec. If you want to output your movie with sound that you have loaded into the VSE, use **FFMPEG**.

If you are going to do post-processing on your movie, it is best to use a frame set rendered as **PNG** images; if you only want one file, then choose **AVI Raw**. While AVI Raw is huge, it preserves the exact quality of output for the post-processing. After post-processing (compositing and/or sequencing), you can compress it down. You don't want to post-process a compressed file, because the compression artifacts might throw off what you are trying to accomplish with the post-processing.

Note that rendering an animation long to calculate in a unique file (AVI or QuickTime) is more risky than in a set of static images: if a problem occurs while rendering, you have to re-render all from the beginning, while with static images, you can restart the rendering from the place (the frame) where the problem occurred!

Post Processed Effects

There are several effects you can enable in the Render Settings that add visual elements to rendered images, after the rendering has completed. These are not done in camera, but rather composited on top of the image.

Composited and Sequence are discussed in [Output Options](#).

Fields are discussed in [Video Output](#).

Render Layers

Render layers are used to separate your composite image into layers. Use Render Layers for a specific reason - such as creating depth of field, relighting isolated elements within the image via a normal pass, adding a colorcast to specific portions of the image, etc. The keyword here is isolation. Render layers allow you to dissect, effect and or correct individual elements or groups within your composition before outputting your final render. This saves you from endlessly re-rendering your scene just to find out whether a correction is going to work or not.

Render Layers in Compositing

What are Render Layers *really* used for? Blender's node-based compositing system!

In Nodes, when you added an Input Node of type *RenderLayers*, and selected the Scene, you bring in whatever information you've specified for that RenderLayer. This node becomes a source for the rendering pipeline products you've specified (*see below*), as applied to the objects in the qualifying layer(s). Each of these products then "flow out of" that node toward their appointed destinations in the node graph you've constructed.

Layers or Passes?

Blender's [Render Pass](#) system is a subset of Render Layers. Passes are specific to elements of shading properties, such as specular and diffuse, which can later be combined in compositing. Render Layers are more geared for separating scene components, but can include isolated passes as well.

Using Render Layers

In Render buttons, open the Layers tab. This is where you select the layers that you want to render, and the settings for the upcoming render.

Enabling and Naming

The list box contains the Render Layers that you have created, and options for disabling, removing, adding, and renaming layers.

Note that the settings in the Layers tab are Render Layer specific. Make sure that you have the appropriate Render Layer selected when changing settings.

The checkbox enables or disables the computation of the whole render layer. Enable only those layers you are working with to save time. The selector allows you to scroll through and examine existing render layers, or to add a new one.

Creating a new Render Layer

By default, there is 1-Renderlayer created for you, and it includes all layers, whether they are used in your scene or not. To add yet another Render Layer, click the yellow up-down selector and select Add New render layer. You now have two Render Layers to choose from, and the active one is shown in the window. Each Render Layer will have its own set of layers that are rendered (sort of makes sense now, doesn't it?).

For example, you might have a robot in a scene with a ground object, buildings, etc. If the robot is on visible-layer 5, you would create one render layer named "Robot" with layer 5 selected in both the Scene: and Layer: buttons.

You would create another render layer (maybe named "stuff") that had all other layers EXCEPT layer 5 selected in both the Scene: and Layer: buttons. Then, back in the Node Editor, you would create TWO input nodes of type Render Layer: one for the Robot Render Layer, and another for the other Stuff. Run both through a mixer and out to the Composite viewer to get the big picture.

Scene Layers Settings

There are three sets of scene layer buttons:

Scene



These mirror the layer buttons in the 3d view header, and tell which scene layers are visible when rendering.

Layer

Control which scene layers are included in the current Render Layer.

Mask Layers

The image rendered is from the objects that are between the selected layer(s) and the Z-mask layers. In the example, the cube is on layers 2 and 3, and the grass is on layer 1. In the render layer which we have arbitrarily chosen to call "zmask", as shown in the picture above, layer 1 is selected and layer 3 is designated as the Z-mask (as indicated by the black dot). Therefore, only that part of Layer 1 which is in front of the object on layer 3 (the cube) is rendered.

You can select that layer by LMB  clicking the button. To select multiple layers, ⇧ Shift LMB  click. (The dot in the button in this case turns *dark gray*.)

Layer Sets AND each other

Only the objects in layers that are selected BOTH in the main Scene Layer group AND the Render Layer Layer group will be rendered. So, if the Scene has only Layer 1 selected, and your Render Layer set specifies to render only Layers 2 and 3, nothing but the Sky (if selected) will be rendered.

Overrides

The Light and Material selector boxes allow you to override materials and lights per layer, applying them to all objects in the Render Layer.

Light
Enter the name of a light group, and the scene will be lit with only those lights. Usually, you use this to speed up draft renders, of a scene that has complicated lighting, by entering the name of a small group of key lights.

Material
Overrides all material settings to use the name of the Material entered. Use this to speed up draft renders. Use the default material to check basic lighting.

Include Options

Each render layer has its own set of major products to include in the rendering pipeline. To save time and give you control when working with passes, this set of buttons allow you to select which major products to render:

Z-mask
Only render what's in front of the solid z values.
Negate
Only render what's Behind the solid z values.

AllZ
Z-values are computed for everything in view, not just those things that are rendered. When disabled, objects not included in the render have no ("infinite") z value.

Solid
Solid faces are rendered. All normal meshes are solid faced.

Halo
Halo materials are rendered

Z-transp
Transparency may be Z-based or Ray-traced. If Z-based, enabling *Ztra* renders transparent areas with the z-value of what is behind the transparent area.

Sky
Turning on Sky renders the sky, as defined in your material world settings. Otherwise, a black alpha transparent background is rendered

Edge
If Edge is enable in the Output panel, objects in this renderlayer are given an outline edge. Turning on Edge pulls in the Edge settings from the Output tab, and adds an outline to the objects. Edges have to also be enabled on the Output tab.

Strand
Strands are strings of static particles that are colored as part of the material settings; they look like strands of hair, or grass.

Passes

Render Passes (Combined, Z, Vec, etc.) are discussed on [the next page](#).

Examples

Rendering only certain objects

For example, suppose you have added a cool halo to your robot and you want to quickly see what it looks like. Suppose your scene has boxes on layer 1, laser rifles on layer 2, the robot on layer 5, and lights and camera on layer 20, and they are all selected and visible in 3d view. If you want to render just your robot, and he is on layer 5, you click on the render layer 5 button (which is below the Render Layer name), de-select sky (so that the sky/horizon is not rendered) and select Halo. Presto! When you render, only the robot is rendered (quickly) and not all the other elements of your scene (like the boxes he is running in front of).

Outlining only selected objects

To render an image where only one or two of the objects are outlined, move those objects onto layer(s) separate from everything else. Create a 1-Render Layer for those layer(s) by selecting only those layers in the Render Layer layer set. Create another 2-Render Layer for the other stuff. Enable the Edge option for 1-Render Layer (remember to also enable Edge on the Output tab) and make sure it is de-selected (off) for 2-Render Layer. In the Node Editor, create two input nodes, one for each Render Layer. Mix the two images. Done. Simple. Yea.

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Proposed fixes: none

Render Passes

Render Passes are the different things the Blender Render Engine must calculate to give you the final image. In each 'pass' the engine calculates different interactions between objects

Render Passes In Detail

Everything you see in a render must be calculated for the final image. All interactions between objects in your scene, lighting, cameras, background images, world settings, etc. must all be separately calculated in different passes for different reasons, such as calculating shadows.

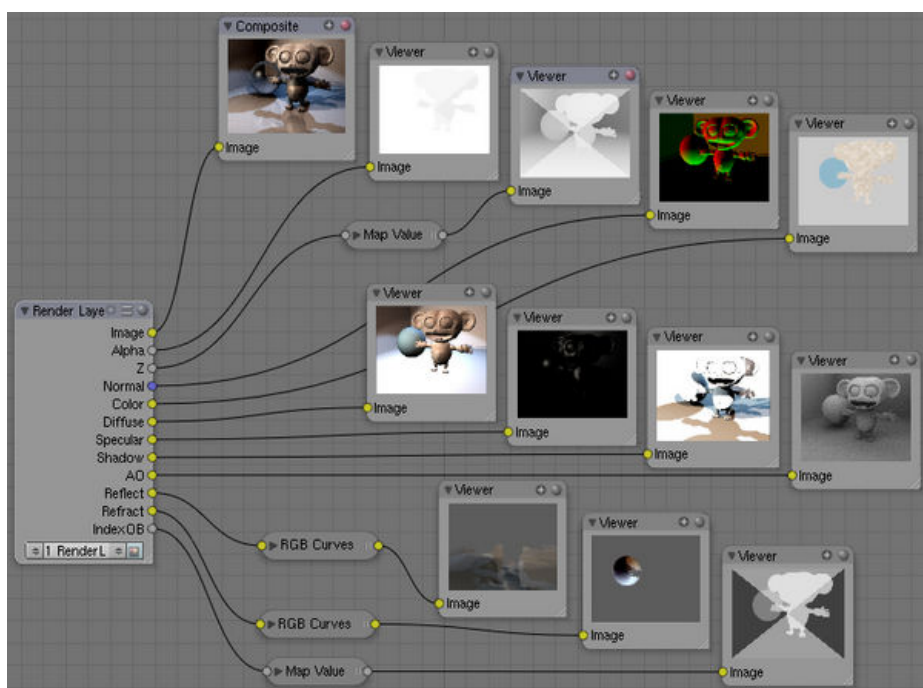
In a render, every pixel has been calculated several times to make sure it will show the right color for the right part of the image. Various things that are calculated in a standard render include:

- *Where are **shadows** cast?*
- *How is **ambient** light in the environment blocked (**occluded**) by objects in the scene?*
- *How is light **reflected** off mirrored surfaces?* Like shadows, lines are calculated, except this time they come from the camera and bounce of mirrored surfaces, so that when these lines hit an object, the engine calculates that this is what the camera should see
- *How is light bent (**refracted**) as it passes through transparent objects?* Does it go straight through? Does it bend? If so, at what depth in the object?
- *What designated **objects** are in the scene, and what is their outline?* Should the object appear blurred, or should it appear in sharp focus?
- *How fast is something moving (**velocity**)?* Should it appear blurred with our frame rate or is it slow enough to still be focused on properly?
- *How far away from the camera are objects' surfaces (**Z-depth**)?* Can the object's surfaces be seen at all, or are they being blocked by another object's geometry?
- *Does an object have a **normal** vector (bumpmap)?* Do shadows and apparent geometry need to be calculated for any objects?
- *Is there any **specularity**?* Are objects with textures such as metal shiny at all?

Renderer Rewrite

Starting with Blender 2.42, the render engine was rewritten. See [Unified Renderer](#) if you are using an old version of Blender.

The answer to each of the above questions is an image or map, shown below:

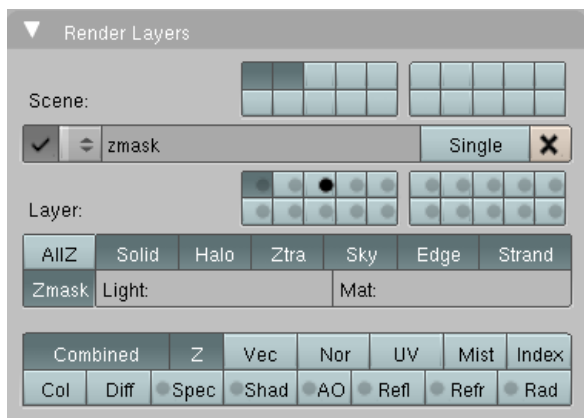


Each Render Pass puts out an image or a map. For the purposes of this example, a Render Layer was defined to produce all possible outputs. When a Render Layer input-node was added to the node diagram and the Render Layer input-node was subsequently associated with the Render Layer, all of the layer's outputs appeared as connection points on the right-hand (output) side of the node.

Render Passes that produce Images can be directly viewed in a viewer, or, if they are the only pass that is rendered, saved as the render image. If the pass is enabled, it can be saved in a multilayer OpenEXR format.

If the Render Pass output is not an image but is a map, it needs to be translated into something that we can see. For example, the Z-depth map is an array of values that specifies how far away from the camera each pixel is; values range between +/-3,000,000 blender units or so. The intermediate node you see above, between the RenderLayer output socket and the Viewer node input socket (such as Map Value) does this translation or scaling. You must use that specific kind of translation node to get good results if you intend on operating on that map as an image. You must then, after making any adjustments, run the map back through that node to re-scale it back to original before saving.

Selecting Render Passes



RenderPasses are the various distinct outputs that the renderer is able to generate. All of the following render outputs are normally combined into a single output known, appropriately enough, as the **Combined** output. But you can also select any of them to be output as a separate pass. (If you do so, in most cases you can choose whether to *also* continue to include it in the Combined output.)

Some of these outputs must be enabled and used within your scene (and not just selected in the Render Layer panel) in order to show anything. For example, if you do not have any lights in your scene, or those lights have been set to not cast shadows, or objects in the limelight do not have materials which have been set to receive shadows, the **Shadow** pass will be blank; there's simply nothing to show you. If you have not enabled *Ambient Occlusion* in your World environment settings, the **AO** pass will be blank, even if you select it here.

To save time and disk space, you have to tell Blender each of the passes to render in the Render Layers panel (which we first introduced on [the previous page](#)):

Combined	This renders everything in the image, even if it's not necessary. ("The whole enchilada" so to speak.) This is all the options below, blended into a single output, <i>except</i> those options which you've indicated should be omitted from this pass, as indicated with the camera button.
Z	The Z-depth map; how far away each pixel is from the camera. Use for Depth-Of-Field (DOF). The depth map is inverse linear (<i>1/distance</i>) from the camera clip start.
Vector	The direction and speed things are moving. Use with Vector Blur
Normal	Calculates lighting and apparent geometry for a bumpmap (an image which is used to fake detail on an object) or for changing the apparent direction of light falling on an object.
UV	Allows texturing after rendering. See UV node.
Mist	Deliver Mist factor pass
Object Index	masks selected objects. See MaskObj node.
Color	The color of materials without shading
Diffuse	The diffuse shading of materials
Specular	Specular highlights
Shadow	Shadows cast. Make sure shadows are cast by your lights (positive or negative), and received by materials. To use this pass, mix multiply it with the Diffuse pass.
Emit	Emmission pass
AO	Ambient Occlusion. Make sure it's turned on in your environment and that RayTracing is enabled.
Environment	Environment lighting.
Indirect	Indirect lighting pass. Reflection off mirrors and other reflective surfaces (highly-uv'd white floors, for example). Mix: Add this pass to

- Reflection** Reflection on mirrors and other reflective surfaces (highly waxed white floors, for example). Mix Add this pass to Diffuse to use it.
- Refraction** Refraction of colors through transparent meshes. Mix Add this pass to the Diffuse pass to use it.

When you enable a pass, the appropriate socket on the Render Layers node shows up like magic, and can be used as shown in the example above.

Excluding Render Passes

As we said, the **Combined** output is an amalgam of several outputs which are *also* available separately. When you select one of these outputs, they will be provided separately *and also* included in the Combined pass.

When you enable the Camera icon that is beside several of the pass options, the particular pass will be excluded from the combined pass. They will be made available separately *but not* included in the combined pass.

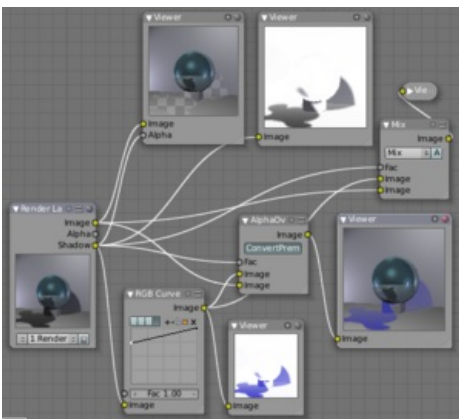
Using Render Passes

The primary purpose of Render Passes is to enable you to process the various outputs in different ways, by constructing networks of render nodes. You can achieve many special effects, and economize considerably on the render times of complicated scenes, by creative and effective use of this facility. We'll show you a few examples of this in just a moment.

Quite a bit of information about the typical uses for some of the passes is discussed elsewhere:

- Image: Since this is the main product, all of Blender uses it.
- Alpha: See the *AlphaOver* node and all of the *Matte* nodes
- Z: See the *Defocus* node
- Vec: See the *Vector Blur* node
- Normal: See the *Normal* node

Recoloring Shadows



Let's run the Shadow buffer through a colorization noodle, then recombine it and all your shadows will be artificially colored. Lots of threads in this noodle shown to the right, so let's walk through it. On the left is the Render Layer input node: it refers to one of the Render Layers that we have defined for our scene. In the scene, we have a reflective ball on a pedestal standing in front of a backdrop. Everything (except the ball) is gray. We use a standard four light rig: backfill placed high, two sidefills at ground level, and a key light above and to the left of camera. Suzanne, a monkey shaped geometry, is standing in front of the key light, so her shadow is cast into the scene on the floor. The ball casts shadows onto the backdrop and floor.

The output channels of the Render Layer node are determined by which buttons we selected when defining our Render Layer. The top two viewers show you the image output using the Shadow as the Alpha channel, and the node next to it the Shadow channel. Where the Shadow is dark, the image in the left viewer is transparent. We have used the Shadow to cut out parts of the image.

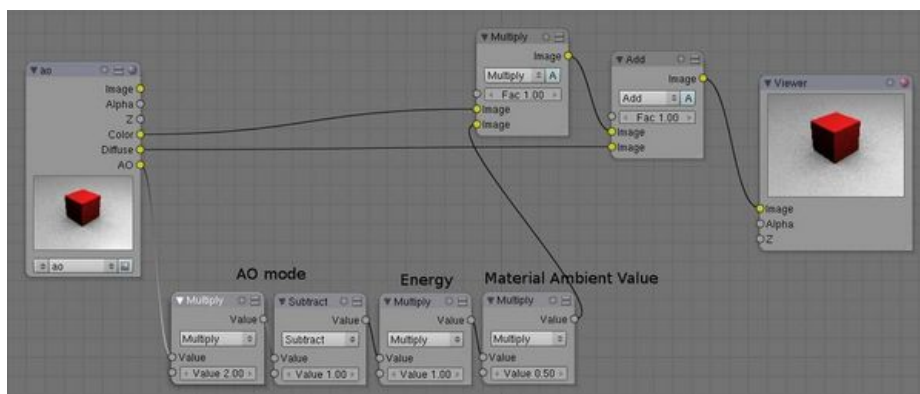
We then take the shadow through an RGB Curve, which is set to magnify just the Blue by 75%; so a gray shadow of (R:40, G:40, B:40) becomes (R:40, G:40, B:40x1.75=70). That blue-tinged shadow is shown in the bottom viewer. Now we have two options: AlphaOver and Mix. For either option:

- Use the Shadow map as a Factor
- Feed the Blue Shadow to the Top Socket
- Feed the core or base image to the Bottom Socket

The resulting image is the same in either case; a blue shadow. Note that Suzanne's reflection is not blue; there's a different Render Pass for that.

You could just as easily swap in another image entirely; for example, the shadow map from another render layer. You can even take an image from another project entirely and use that instead (using the Image Input node), to get a different effect. (For example, an effect similar to a *Star Wars Episode One* movie poster, where Anakin Skywalker already casts the shadow of Darth Vader.)

Compositing Ambient Occlusion



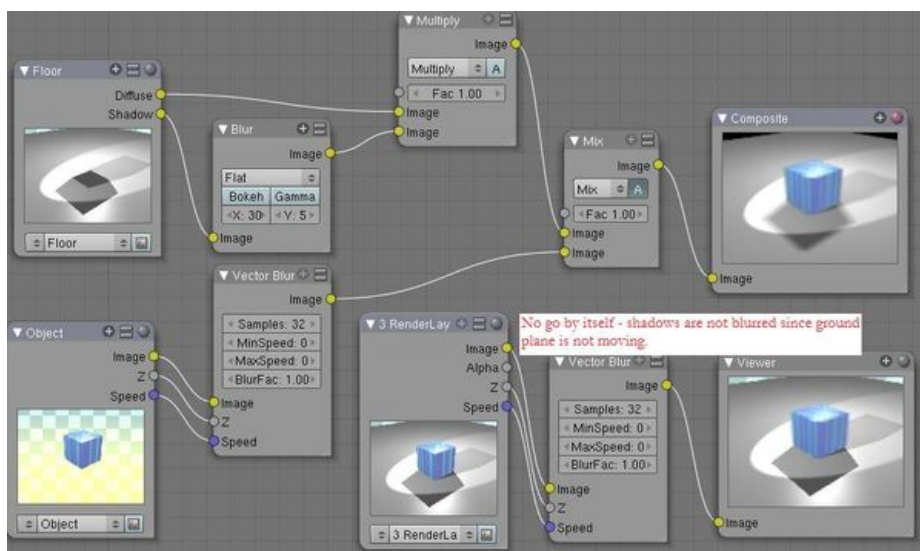
AO is a geometry-based dirt shader, making corners darker. It is separately enabled in the World settings and computed as a separate pass. When enabled, it has one of three Modes (*Add*, *Subtract*, *Both*), and variable *Energy* level (which changes the intensity of the shading). The third variable is the amount of Ambient light that the material receives. If it does not receive any, then ambient occlusion does not affect it. Based on these variables, Blender computes an AO pass. If you call it out as a separate pass and wish to composite it back into your image, you will need to enable the Color and Diffuse pass as well.

To configure your noodle, consider the example image above.

1. First, depending on the AO mode do one of the following: If AO mode is Add: directly use the AO pass. If AO mode is Sub: Calculate $AO - 1$, or if AO mode is Both: Calculate $2 * AO - 1$
2. Multiply the output of Step 1 with the AO energy level
3. Multiply the output of Step 2 with the material's ambience value. If you have materials which receive different ambience light levels (0.5 is the default), one would have to create an ambience map based on Object ID
4. Multiply the output of Step 3 with the color pass
5. Add the output of Step 4 to the diffuse pass

If shadows, colored ambient light, specularity, reflections, and/or refractions are involved they have to be added to the diffuse pass before adding the converted AO pass.

Vector Blurring Shadows



When using Vector Blur, instead of Motion Blur, objects in motion are blurred, but objects at rest (with respect to the camera) are not blurred. The crossover is the shadow of the object in motion. Above, we have a cube in motion across a ground plane. If we just ran the combined pass through Vector Blur, you can see the result in the lower right-hand corner; the box is blurred, but its shadow is sharply in focus, and thus the image does not look realistic.

Therefore, we need to separate out the diffuse and shadow passes from the floor by creating a "Floor" render layer. That render layer has Diffuse and Shadow passes enabled, and only renders the floor object (layer 2). Another render layer ("Cube") renders the Z and Vector passes, and only renders the cube (on layer 1). Using the Blur node, we blur the shadow pass, and then combine the diffuse and blurred shadow by multiplying them together in a Mix Multiply node; we then have a blurred shadow on a crisp ground plane. We

can then mix the vector-blurred object to provide a realistic-looking image.

Conclusion

Render Passes can be manipulated from Blender 2.43 to give you almost complete control over your final image. Causing objects to cast shadows that aren't really their shadows, making objects appear out of focus or sharply in focus like a real camera, manipulating colours just for final post-processing or just reconfiguring your render passes to save render time, are all things which you might wish to manipulate the render engine for.

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Proposed fixes: none

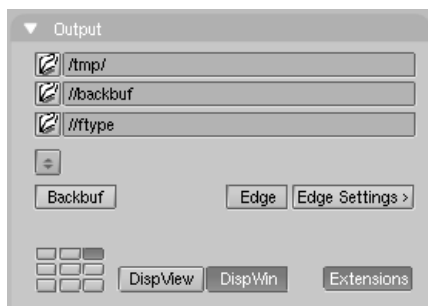
Edge (Toon) Rendering



A scene with Toon materials.

Blender's toon shaders, can give your rendering a comic-book-like or manga-like appearance, affecting the shades of colours. The effect is not perfect since real comics and manga also usually have china ink outlines. Blender can add this feature as a post-processing operation.

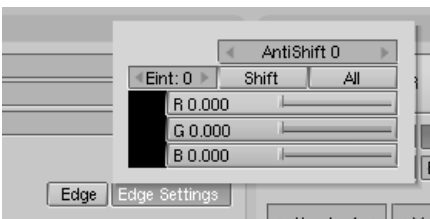
Options



Toon edge buttons (*F10*).

Edge

This makes Blender search for edges in your rendering and add an 'outline' to them.



Toon edge settings (*F10*).

Before repeating the rendering it is necessary to set some parameters:

Threshold

The threshold of the angle between faces for drawing edges, from 0 to 255. A value of 10 would just give outline of object against the background, whereas higher settings start to add outlines on surface edges, starting with sharper angles. At maximum intensity, Edge will even faintly display geometry subsurf edge lines in areas of imperfect smoothing.

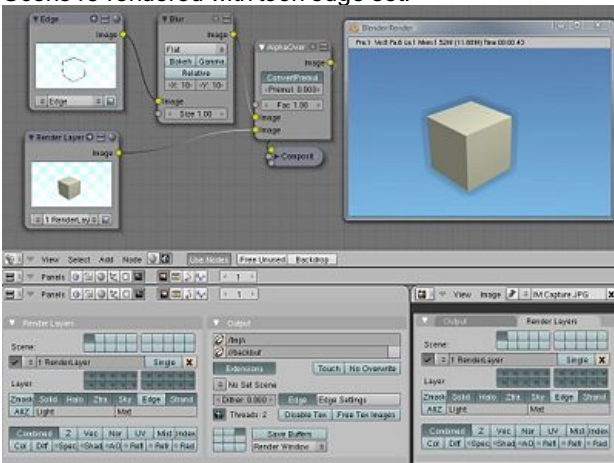
Colour / R/G/B

The colour of the rendered edges (black by default). Click on the swatch to see the color picker

Examples



Scene re-rendered with toon edge set.



It is possible to separate out the edge layer using a renderlayer dedicated to that purpose. The alpha channel is 0 where there is no edge, and 1 where the edge is. By separating out the edge layer, you can blur it, change its color, mask it, etc. The image to the right shows how to do this. I created an Edge renderlayer that only has the Sky and Edge layers (I included sky so that we get the world color later on in the composite output). The other renderlayer omits the Edge layer, so it returns just the normal image. On the output panel I enabled Edge with a width of 10 in black. I run that layer through a blur node. Using the Alphaover node, I then composite the cube on top of the blurred edge. The result gives a soft-shadow kind of effect. Note that Premultiply is set because the Edge image already has an alpha of 1.0 set.

Dithering

Dithering is a technique for blurring pixels to prevent banding that is seen in areas of gradients, where stair stepping appears between colors. Banding artifacts are more noticeable when gradients longer, or less steep. Dithering was developed for graphics with low bit depths, meaning they had a limited range of possible colors.

Dithering works by taking pixel values and compares them with a threshold and neighboring pixels then does calculations to generate the appropriate color. Dithering creates the perceived effect of a larger color palette by creating a sort of visual color mixing. For example, if take grid and distribute red and yellow pixels evenly across it, the image would appear to be orange.

The Dither value ranges from 0 to 2.

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Stamp

The stamp panel includes options for image stamping. Stamping adds text over the rendered image, which can include the following data:

Time
Include the current scene time and render frame as HH:MM:SS.FF.

Date
Include the current date and time.

RenderTime
Include the render time in the stamp image.

Frame
Include the frame number.

Scene
Include the name of the active scene.

Camera
Include the name of the active camera.

Lens
Include the name of the active camera's lens value.

Filename
Include the filename of the .blend file.

Marker
Include the name of the last marker.

Seq. Strip
Include the name of the foreground sequence strip.

Note
Include a custom note.

Stamp Text Color
Set the color and alpha of the stamp text.

Stamp Background
Set the color and alpha of the color behind the text.

Font
Set the size of the text.

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Motion Blur

Blender's animations are by default rendered as a sequence of *perfectly still* images. This is unrealistic, since fast moving objects do appear to be 'moving', that is, blurred by their own motion, both in a movie frame and in a photograph from a 'real world camera'. To obtain such a Motion Blur effect, Blender can be made to render the current frame and some more frames, in between the real frames, and merge them all together to obtain an image where fast moving details are 'blurred'.

The Human Eye

Our brains process about 15 images from each eye in parallel each second. My brain cognates those images together and I perceive motion by comparing the two. If something is moving fast enough, I perceive it to be a blur (either because my rods have some latency in reacting to light, or my brain, in overlaying and differencing the images, somehow merges them in a mix sort of fashion). The POINT IS, I *perceive* a motion blur.

In Film

To keep us from seeing jumpy motion pictures, we simply doubled the frame rate to 30 frames per second (fps) (24 fps EU). So, the shutter is basically open for a 30th of a second and the film is exposed to the world for that length of time. As things moved in the real world during that time, the film exposure caused the image of the moving thing to be physically blurred or smeared on that frame. When developed and shown, we physically see an image that is blurred. The POINT IS, I see a blurred image.

In CG

In CG, when a frame is rendered, the computer knows exactly where everything should be, and renders it as such. From frame to frame, an object is location A in frame 1, and location B in frame 2. When we show you these two frames at speed (30 fps), the image appears jumpy to us, because, somewhere between the eyeballs and the film, there isn't that same blurring as the real world and film, and we can tell.

Motion Blur in Blender

So, how can we make a blurry CG image? Blender has two ways to achieve Motion blur in Blender:

Sampled Motion Blur

This method is slow, but produces better results. It can be activated in the motion blur section in the render options panel.

Motion Samples

Set the number of samples to take each frame

Shutter

Time Taken in frames between shutter open and close

Vector Blur

[Vector Blur](#) is faster but sometimes unwanted side-effects - which can be avoided though. Vector blur is a process done in compositing, by rendering the scene without any blur, and a pass that has movement information for each pixel. This information is a vector, which describes a 2d or 3d direction and magnitude. The compositor uses that data to blur each pixel in the given direction.

Examples

To better grasp the concept let's assume that we have a cube, uniformly moving 1 Blender unit to the right at each frame. This is indeed fast, especially since the cube itself has a side of only 2 Blender units.

Image 1. shows a render of frame 1 without Motion Blur, *Image.* shows a render of frame 2. The scale beneath the cube helps in appreciating the movement of 1 Blender unit.

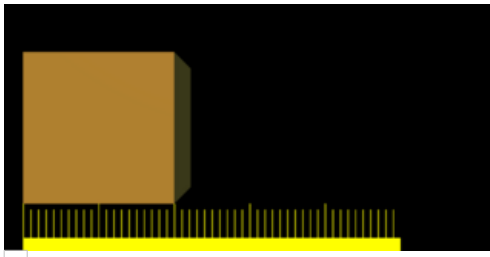


Image 1. Frame 1 of moving cube without Motion Blur.

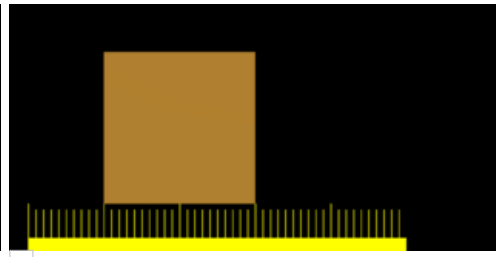


Image 2. Frame 2 of moving cube without Motion Blur.

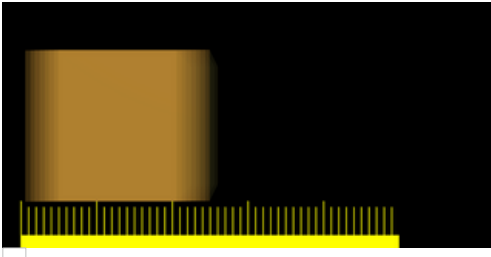


Image 3. Frame 1 of moving cube with Motion Blur, 8 samples, Shutter=0.5.

Image 3, on the other hand shows the rendering of frame 1 when Motion Blur is set and 8 'intermediate' frames are computed. Shutter is set to 0.5; this means that the 8 'intermediate' frames are computed on a 0.5 frame period starting from frame 1. This is very evident since the whole 'blurriness' of the cube occurs on half a unit before and half a unit after the main cube body.

Image 4. and *Image 5*. show the effect of increasing Bf values. A value greater than 1 implies a very 'slow' camera shutter.

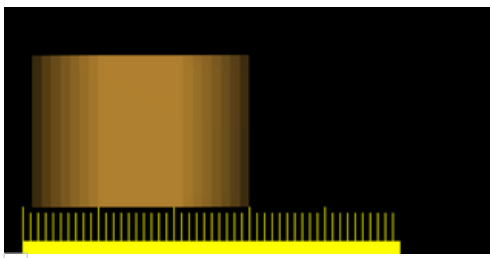


Image 4. Frame 1 of moving cube with Motion Blur, 8 samples, Shutter=1.0.

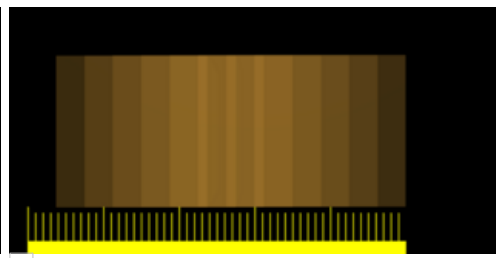


Image 5. Frame 1 of moving cube with Motion Blur, 8 samples, Shutter=3.0.

Better results than those shown can be obtained by setting 11 or 16 samples rather than 8, but, of course, since as many *separate* renders as samples are needed a Motion Blur render takes that many times more than a non-Motion Blur one.

Hints

If Motion Blur is active, even if nothing is moving on the scene, Blender actually 'jitters' the camera a little between an 'intermediate' frame and the next. This implies that, even if Anti-Aliasing is off, the resulting images have nice Anti-Aliasing. An MBLUR obtained Anti-Aliasing is comparable to an Anti-Aliasing of the same level, but generally slower.

This is interesting since, for very complex scenes where a level 16 Anti-Aliasing does not give satisfactory results, better results can be obtained using *both* Anti-Aliasing and MBlur. This way you have as many samples per frame as you have 'intermediate' frames, effectively giving oversampling at levels 25,64,121,256 if 5,8,11,16 samples are chosen, respectively.

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Description

Network renderer from inside Blender

Goals

- Transparency
- Flexibility

Instructions

As of version 2.6, network rendering needs to be enabled under User Preferences -> Addons.

GUI

Master

On one machine, start a Master server.

- Start Blender, switch Render Engine to Network Render using the dropdown in the Info window header (next to Scene)
- Select Master as mode of operation
- *Optional* Specify the IP address of the interface to listen on as well as the port. Leave at *[default]* if you want the server to listen on all network interface on the specified port.
- Press Start (it will open a blank render window). The render status line will reflect the actions of the server
- The Master will run until stopped by pressing Esc, as if canceling a normal render.

Master web interface

When started the master will also present a web interface that provide more information about slaves and jobs. There is currently two web interfaces. The old one can be viewed using the following url scheme `http[s]://master_ip_address:master_port`. The new one based on jquery and in developpement can be viewed using following url scheme `http[s]://master_ip_address:master_port/html/newui`. All information regarding the new web interface can be found [here](#)

Slave(s)

On other machines, start render slaves

- Start Blender, switch Render Engine to Network Render
- Select Slave as mode of operation
- *Optional* Specify the IP address of the master server as well as the port. Leave at *[default]* if you want the slaves to automatically detect the master from its broadcast.
- Press Start (it will open a blank render window). The render status line will reflect the actions of the slave
- The Slave will run until stopped by pressing Esc, as if canceling a normal render.

Client

To send job to the cluster, from your workstation:

- Open the blend file to be rendered. Confirm your render settings (size, etc)
- Save the file (it sends the last saved file at this point)
- Select Network Render as Render Engine
- Select Client as mode of operation
- One of the following:
 - Specify the IP address of the master server as well as the port.
 - Press the Refresh button underneath the address to automatically detect the Master server from its broadcast.
- Press Send Job to dispatch the animation job to the Master server
- Whenever you want, Render the Animation (Ctrl-F12) to gather the finished frames. Finished frames with "appear" automatically while it will pause on ongoing frames.
- You can also hit Render on any frame of the animation and it will fetch the result from the Master.
- In the simplest example, you can just press "Animation on network" and wait for the frames to come in. Total render time should be close to inverse proportional to the number of slaves (minus transfer times).

Command Line

- Configure master and slaves as described previously. Save configurations to separate blend files (ie: master.blend and slave.blend).
- Use background rendering to start the master and slaves like so:
 - `blender -b master.blend -a`

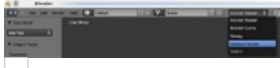
- `blender -b slave.blend -a`
- Master and Slaves can be stopped with Ctrl-C (it is recommended to stop the Slaves before the Master).

Extra

Full multilayer render results are used, so the final results should be exactly the same as a local render. You don't have to specify this as output in the original file, it's done on the slaves automatically.

Testers are invited to contact **theeth** via [IRC \(#blendercoders\)](#) or by email.

Settings



NetRender as a Render Engine

The Render Engine drop down is located in the Info window at the top of the Blender window. This is where you select Network Render to access NetRender features.

Master



Master settings

- Network Settings
 - **Start Service:** Starts the Master Server
 - **Path:** Where the Master will save job files, results, logs and others. It will create a new directory there of the form *master_<pid>* where *<pid>* is the process ID of the Master server. In the root of the folder, a file named "blender_master.data" will be saved to enable resuming a master later.
 - **Server Address:** Address of the network interface that the Master will listen on. *[default]* means listen on all available network interfaces.
 - **Port:** Port that the Master will listen on.
 - **SSL:** Use SSL (https) for connections with slaves and clients. When that option is enabled, two new fields become visible to specify the SSL certificate and key. You can use self signed certificate or certificate provided by third party like comodo,verisign. In that case if there is a chain of trust you can put it in the same file as the certificate but the certificate must be put first. The certificate,the chain of trust and key must be provided as PEM files.
 - **Open Master Monitor:** Open a browser to the Web-based Master monitor. Enabled when the Master is running.
- Master Settings
 - **Broadcast:** Broadcast the Master's Address and Port on its local network (every 10s).
 - **Force Dependency Upload:** Forces clients to upload dependency files to the master, don't use already existing local files even if they match client files.
 - **Clear on exit:** Remove the directory created in *Path* when the Master is stopped. Turning on this option prevents resuming a master later if the process is stopped for any reason.

Slave



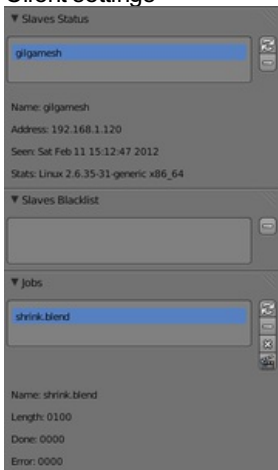
Slave settings

- Network Settings
 - **Start Service:** Start the Slave node.
 - **Path:** Where the Slave will save job files, results and logs. It will create a new directory there of the form *slave_<id>* where *<id>* is the Slave ID assigned by the Master server.
 - **Server Address:** Address on which the Master listens.
 - **Port:** Port on which the Master listens
 - **Refresh:** Listen to the Master's broadcast to determine its Address and Port (can take up to 20s).
 - **Open Master Monitor:** Open a browser to the Web-based Master monitor. Enabled when the Master's address is valid.
- Slave Settings
 - **Tags:** Semi-colon separated list of tags assigned to the slave. A slave will only be assigned a job if it has at least all of that job's tags.
 - **Clear on exit:** Remove the directory created in *Path* when the Slave is stopped.
 - **Generate thumbnails:** Create thumbnails of the render result on the Slave (they are otherwise created on demand by the Master).
 - **Output render log on console:** Also output logs from the rendering subprocess to the standard output and not just to render log sent to the master.
 - **Threads:** How many threads should the Slave use for rendering.

Client



Client settings



Slaves and Jobs lists

- Network Settings
 - **Path:** Where the Client will save its temporary render result file.
 - **Server Address:** Address on which the Master listens.
 - **Port:** Port on which the Master listens
 - **SSL:** Use SSL (https) to communicate with the master
 - **Refresh:** Listen to the Master's broadcast to determine its Address and Port (can take up to 20s).
 - **Open Master Monitor:** Open a browser to the Web-based Master monitor. Enabled when the Master's address is valid.
- Job Settings
 - **Animation on network:** Send the current file as job to the Master and waits for results (other than the rendering taking place elsewhere, this works like a normal Render Animation).
 - **Send job:** Send the current file as job to the Master. The job ID returns becomes the *current job ID*.
 - **Bake on network:** Send a baking job with all modifier using a point cache or particle systems in the scene,
 - **Send current frame job:** Send the current file as job to the Master with the current frame to be rendered only. The job ID returns becomes the *current job ID*.
 - **Name:** Name of the job. *[default]* uses the name of the blend file.
 - **Category:** Category of the job, *Optional*. Jobs on the Master are also balanced by Categories.
 - **Tags:** Semi-colon separated list of tags assigned to the job. A job will only be assigned to a slave if its tag list contains all of the job's own tags.
 - **Engine:** Render engine to use for rendering this job.
 - **Priority:** Priority of the job. The Priority level is a multiplier that makes the Master count the job as if it were X jobs (ie: balancing between a priority 1 and a priority 2 job will make them take 33% and 66% of the workload respectively).
 - **Chunks:** How many frames are dispatched to a Slave as part of a chunk of a job.
 - **Save Before Job:** Force the current file to be saved to disk before being dispatched as a job.
- Slaves Status
 - **List:** List of all Slaves connected to the Master.
 - **Refresh:** Refresh the Slaves information from the Master
 - **Remove:** Move the selected Slave to the Blacklist.
- Slaves Blacklist
 - **List:** List of all Blacklisted Slaves.
 - **Remove:** Remove the selected Slave from the Blacklist.
- Jobs
 - **List:** List of all jobs on the Master.
 - **Refresh:** Refresh the Jobs information from the Master
 - **Remove:** Remove a Job from the Master.
 - **Remove All:** Remove all Jobs from the Master.
 - **Get Results:** Get all available frames from the selected Job. Results are downloaded as multilayer EXR into the current output directory.

Physics Baking Jobs

Physics baking is a recently added feature in Netrender. It supports dispatching baking jobs for each point cache used in a scene (on a modifier or particle system).

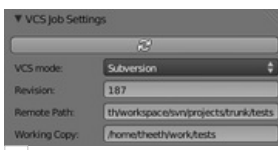
Each point cache will be baked individually on a slave, baking ordering and dependencies are not currently supported.

Results can only be downloaded as a zip file from the job's page on the web interface. You then have to unzip them and put the results in the blendcache folder associated with your file and turn on disk cache for modifiers and particle systems that you wanted to bake (this step should be done automatically at some point).

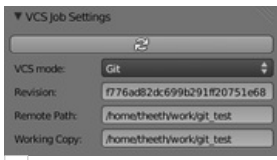
The text outputted by baking a point cache is not terribly well suited for being piped to a log and not very informative, so you won't get a whole lot of information from the job's log file. Changing this would require some change to the baking code directly.

Baking other type of physics (like fluids) should eventually be supported.

Version Control Jobs



Subversion settings
example



Git settings example

Using VCS (version control system) as a job type enables you to bypass the usual dependency system used by netrender and rely on a versioning system instead. For more organized productions, this is usually a good idea as it minimizes dependency errors, disk space used and job dispatch time.

Currently, the only two version control systems supported are Subversion (svn) and Git. Adding new ones is relatively easy and will be done when requested.

After selecting a VCS, you have to specify three system specific settings:

- - **Revision:** string used to identify a specific version. (svn: revision, git: commit hash)
 - **Remote path:** remote path where the files can be downloaded from (svn: server url, git: remote repository path from which the slaves can checkout). All job files must be in that folder or one of its subfolder.
 - **Working copy:** working copy root folder. Where the remote files will be downloaded. This is kept between jobs to prevent download the same files more than once and will only change when jobs require a new revision of specific files from the version control system.

The Refresh button will try to guess those settings to the best of its knowledge.

Notes and Known Bugs

- No shared network space required between nodes
- You can dispatch many different files, all results can be retrieved independently (save the file after the dispatch if you want to close it and retrieve later).
- There is very little network error management, so if you close the master first, stuff will break. Same if you enter an invalid address.
- Issue with many dependencies with the same file name: https://projects.blender.org/tracker/index.php?func=detail&aid=25783&group_id=9&atid=498

Yes, I know the current workflow is far from being ideal, especially from a professional render farm point of view. I expect Matt to whip me and suggest better stuff. Optimally, I'd like if users could just press "Anim on network", it would automatically dispatch to the network and wait for results, like a local render. All "pro" features should be optional.

Load Balancing

Primary balancing is performed by calculating usage of the cluster every 10s for each job, averaged over time. The next job dispatched is the one with lowest usage (the one that is using the lesser number of slaves). The priority of a job acts as a divisor, so a job of priority 2 would use a percentage of the cluster as if it were 2 jobs and not just one (ie: a job of priority 1 and one of priority 2 sharing slaves will use respectively 33% and 66% of the processing power). On top of that, there's a set of exceptions and first priority rules:

Exceptions

- A single job cannot use more than N% of total slaves, unless it's the only job. That prevents slow job from starving faster ones. This is set at 75% for now, but should be customizable.

First Priorities (criteria)

- Less than N frame dispatched (prioritize new jobs). The goal of this is to catch errors early.
- More than N minutes list last dispatch. To prevent high priority jobs from starving others.

To do

- Send job from memory
- Don't depend on render engine choice for visibility
- "Expert" render manager
- Better defined communication protocol
- The option to calculate simulations (cloth, smoke, ...) on a node which would then send point cache to server for dispatch to render
- Pack textures on upload
- Dispatch single frame as tiles

Technical Details

Out of date, read the code and put info here.

Feature List

- support paths instead of files
- client-server-slave: restrict job to specific nodes
- client-server-slave: view node machine stats
- client-server-slave: reporting error logs back to manager (all `stdout` and `stderr` from nodes)
- Cancel jobs
- Restart error frame
- Disable crash report on windows
- Dispatch more than one frame at once (a sequence of frames)
- Blacklist slave that errors on frame after reset
- Multiple paths on job announce
- Delay job until all files accounted for
- Frame range restrictions (ie: send point cache files only when needed for the range of frames)
- Send partial logs to master
- TODO: Set slaves to copy results on network path
- TODO: client-master: archive job (copy source files and results)
- TODO: master-slave: restrict jobs based on specs of slaves.

API Feature Wishlist

This is a list of blender code I would need to make netrender better. Some of them are bugs, some are features that should (hopefully) eventually be there.

- API access to jobs, to be able to run masters and slaves in the background as well as render job notifiers on the client.
- Render result from multilayer image in memory
- Render and load tiles in render results

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Proposed fixes: none

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Blender produces all the information needed to render a scene. While it has its own internal rendering engine, you can export or link to external renderers for image computation.

One of these is Yafaray, and an overview and quick start guide is provided here. For more detailed information, consult the [Yafaray web site](#).

Description

[Yafaray](#), as the lengthened version of its name (Yet Another Free RAYtracer) suggests, is a free, XML speaking, cross platform raytracer developed by the [Yafaray team](#). It works with many 3D modelling applications (with Wings and Aztec serving as examples), but the focus on this document shall fall upon its use with Blender.

Yafaray is currently available (under the [LGPL license](#)) for Windows, Linux (via source code compilation, or .deb or .rpm installation), Mac OSX, and Mac Intel; and installation packages, as well as Yafaray's source code, can be downloaded [here](#).

Options

Blender releases between 2.34 and 2.5x have the option to call Yafaray in the place of Blender's internal renderer (assuming it's installed). This can be done by selecting "Yafaray Render" from the drop-down engine selector menu on the Info header.

Render Pipeline

When Yafaray is used, it is inserted into the pipeline before any compositor or sequencer actions, because it is the renderer, and the compositor and sequencer work on rendered images. The image data given to Yafaray is the scene objects, materials, lights, etc. Yafaray does not know nor care about render layers and cannot feed Blender's node compositor or sequencer effects, since it takes a completely different approach and cannot produce the different render layers that the Blender internal renderer can. Yafaray renders frames based on Blender scene data.

To use Yafaray with Blender's compositor, render the image using Yafaray, and then use the image input node to get that image into the compositor where it can be post-pro. You can then feed that to Sequencer via the Scene strip and Do Composite enabled. To feed the Sequencer directly from Yafaray's output, use the Image strip after Yafaray has completed the render.

Two other panels should appear once Yafaray's selected from this menu, which serve to supply a number of Yafaray's options to you (other options are available exclusively as XML code).



Enabling Yafaray

XML

This button, if pressed, will export your scene to a .xml file in your system's 'tmp' directory before Yafaray renders it. Useful if you wish to make modifications to the XML file, or render the scene from a command line interface. Should you wish, however, to view Yafaray's progress during a render in Blender's render window, it's better to unclick this button.

AutoAA

This options allows you to toggle between manual and automatic control of anti-aliasing options in the scene. Anti-aliasing is similar to Blender internal's OSA, which in effect dictates the accuracy of the edges in the render.

In cases where you may need to manually control the anti-aliasing options (which becomes necessary if you wish to make use of Yafaray's depth-of-field option), it's useful to remember that increasing the amount of samples per pass will increase the accuracy of the edges in the final render; decreasing the amount of samples per pass will, as you'd expect, decrease the accuracy, causing edges in the scene to seem rough, and jagged.

Proc.

This option allows you to select the number of processors Yafaray's allowed to make use of. For those of us who aren't lucky enough to have multiple processors, it's best to leave this option as it's default.

Gam.

This option allows for manual correction of gamma values in the scene. The default (1) turns this option off.

Exp.

This option allows for manual adjustment of exposure levels in the scene. A more indepth explanation of this option will come later.

Global Illumination



Global illumination settings

The next tab along, titled "Yafray GI", provides a selection of methods with which Yafray's able to light a scene. Methods available are:

Full

This method works well for most scenes, most notably indoor scenes, where the use of photons becomes appropriate.

Skysdome

This method is more suited to outdoor scenes.

Cache

Clicking the **cache** button speeds up rendering by allowing Yafray to be more selective it's distribution of samples. When this button's depressed, Yafray renders a pre-pass to determine the most suitable allocation of samples, before rendering the image itself, increasing the efficiency of the render.

The cache button then reveals three more options.

ShadQu

This option allows for greater control over the quality of shadows. By increasing this option from its default (0.900), you also increase the number of samples taken in shadowed areas, which in turn not only increases the quality of shadows in the scene, but also increases render times.

Prec

This option sets the maximum number of pixels per-square without samples. By decreasing this option from its default (10), you increase the number of samples taken in the scene. Decreasing this option also increases render times.

Ref

This option allows the user to specify the threshold to refine shadows. By decreasing this option from its default (1.000), you invite Yafray to increase the number of passes taken to distribute samples in shadowed areas, thereby increasing the quality of the shadows in the scene, and increasing render times.

Examples

Starting with the default Blender set up, enable Yafray in the Rendering Buttons panel (F10), deselect the XML option in the "yafray" tab, and select the "full" method from the "yafray GI" tab, and set the quality to "low". Then click "Render" (F12).

Console output

Provided the environment allows it, Yafray should output information to the console window (in Windows, Blender opens along side a console window by default. In GNU/Linux, however, to view the console output, you'll need to start Blender from the console - Usually by typing "blender" into a terminal emulator window).

If you switch to the console after the render's completed, you should (provided the "cache" option's enabled) notice something similar to this:

Console output

Launching 1 threads

Fake pass: [#####]
534 samples taken

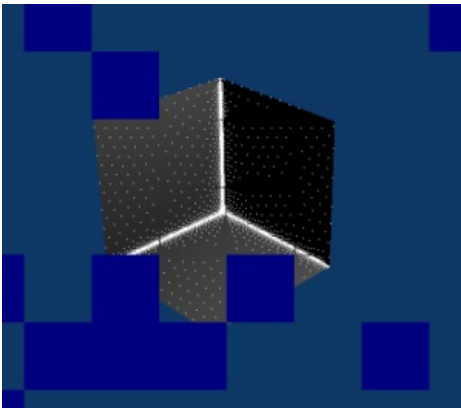
Render pass: [#####]
render finished

Output description

The render's split up into two separate passes. The first, "fake" pass is made as a direct result of the "cache" option being enabled, and it's purpose is to determine the best distribution of samples in the scene (without the cache option enabled, the samples are distributed evenly among the scene). The number of samples is then output onto the next line.

The next pass is the "real" render pass, where Yafray renders the image based on the sample map created in the previous pass.

Render window output



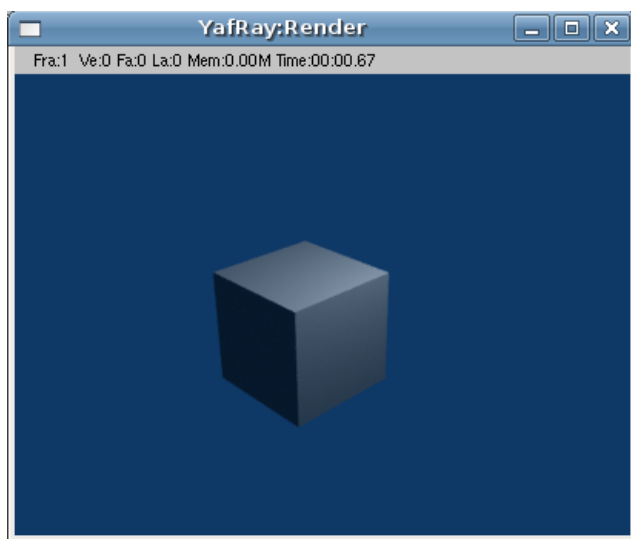
Greater samples in shadowed areas

Now we'll look at the Yafray's output to the render window, during the render.

Provided the XML option is turned off, Yafray will continually update it's visual output to the render window - Much like Blender does. The image to the right was captured during the "fake" pass stage of the render, and the white dots represent the allocation of samples in the scene. Notice how the samples are only placed on areas of the scene that are directly affected by light, meaning that, in the demonstration image, only the parts of the scene with a surface are considered.

This also means that in shadowed areas of the scene, the number of samples is greater.

You can notice that the density of white dots which, as I pointed out earlier, represent the number of samples per pixel in that area of the image, is greater in areas that are likely to be shadowed (in this case, I deleted the vertex of the cube closest to the camera, revealing inside edges, which aren't as exposed to the light).



Basic Yafray render

The rendered image

You'll notice how the cube, despite Blender's default grey material being applied, has been coloured blue. This is because the Full method is affected by the "world" colour of the scene, which, again as Blender's default, is blue. To change this, switch to the "shading" panel (F5), and select the little world icon. To have materials show properly, set the world shader to white.



Selecting the world shader

Notes

Amount of Light



YafRay deals with light completely differently than the Blender Internal Renderer, and apparently light intensity needs to be pumped by large amounts for YafRay. The images reflect a Blender Internal, a YafRay render without Global Illumination (GI), and one with Full GI. As you can see, results vary widely based on the illumination method chosen.

A solution is to use very large Area lamps (Square, 100 Size but Samples at only 4, Energy 10) for softer shadows, in combination with a Sun lamp at much lower Energy value (less than 1.0) if you want a distinct shadow edge. Sun lamps seem to provide much greater intensity than Area lamps in YafRay but the shadow edges are quite harsh.

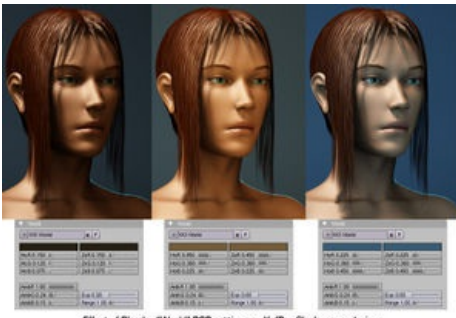
Try using the Skydome setting for the YafRay GI because with Full GI you may get weird blotchy artifacts that no one seems to know how to remedy, but may be related to the scale of my Blender scene, which is 1BU = 1cm, with a figure built to life-size. You'll be doing something like this as well if you build a scale model to match camera perspectives.

Blender World parameters may include a small AO setting which YafRay does seem to take into account, so you might try adding some in your scene. Also be aware that the World Sky colors (Ho & Ze) are treated as a "hemi" light source, and will color your scene accordingly when using Skydome -- play with these RGB values to perhaps boost the overall lighting intensity by "filling in" with GI. In the pics below, the World lighting settings were doubled for the render on the right.

Everything seems to need to be boosted for YafRay -- some Materials look very dull unless you "double-up" some of the components (such as by using an image texture twice with "Add"), and the RGB & Shader tab settings are very different from what you would use with the Internal renderer.

You can also adjust the EmitPwr and Exp settings in the YafRay renderer tabs to compensate for the lighting differences. It gets to be quite a juggling act. The plus side is that you are able to get lighting of a much richer character for a scene, so it can be worth the trouble.

SkyDome



Effect of Blender "World" RGB settings on YaRay Skydome renderings



Various coloring effects based on World settings

Using the Blender Internal (BI) renderer, the only way to get the world Horizon, Zenith, or Textured color to affect the material color is to use Ambient Occlusion set to Sky Color or Sky Texture; otherwise (without AO) it only affects the color of the background. The only variable to directly affect the final object coloration in Blender Internal is the color of Ambient light, and then each material can receive a specified amount of that ambient light (by default 50%). The color of the ambient light in BI cannot be varied over the height of the image and is applied uniformly to the subject. Ambient Occlusion, based on the settings, affects the color of the model based on its geometry.

In YaRay, however, a key difference is that the color of all of these matter, as shown in the example. The example has the same material (the skin and hair) rendered using different **Horizon and Zenith** colors. Each of these, in effect, change the ambient light cast onto the subject. If the Zenith was darker, as is usually the reality, the tops of the model would be darker than the the lower portions. Using the color of the sky and horizon to affect the lighting of subjects lends a much more realistic blending of a subject into the environment, leading to more photorealistic results.

To achieve the same effect in Blender, you can use Ambient Occlusion, or light your subject with Hemisphere lamps which are the same color as your sky zenith and horizon.

Page status ([reviewing guidelines](#))

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Proposed fixes: none

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Cycles Render Engine

Cycles is a new render engine available since Blender 2.61. It is still under development, and intends to become a render engine with a focus on interactivity and ease of use, while still supporting many production features. [Developer documentation](#) is also available.

[Getting Started](#)

Cycles is bundled as an addon that is enabled by default. To use Cycles, it must be set as the active render engine in the top header. Once that is done, interactive rendering can be started by setting a 3D view editor to draw mode Rendered. The render will keep updating as material and object modifications are done.

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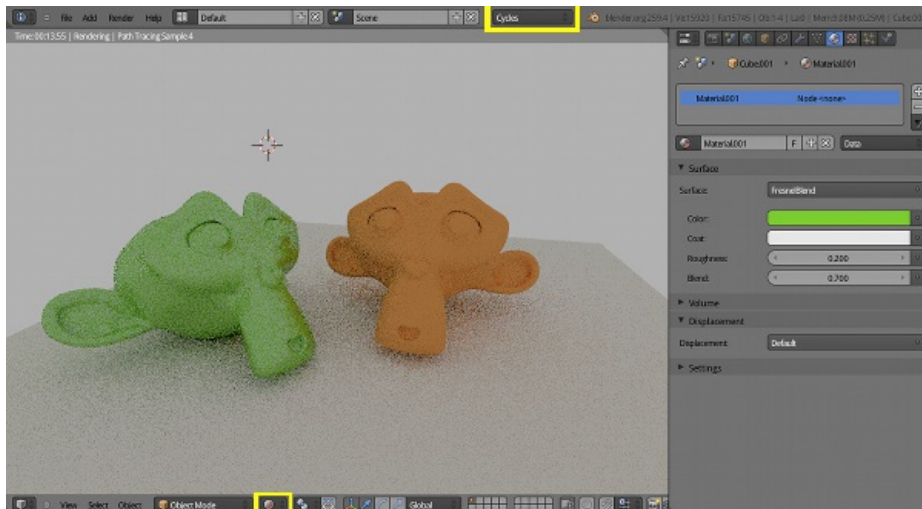
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Getting Started

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To see if and how you can use your GPU for rendering, see the documentation on [GPU Rendering](#).

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- [An Animated Pin Toy \(BlenderDiplom\)](#)



- [How to create hoar frost in Cycles \(BlenderDiplom\)](#)



- [Create a Realistic Water Simulation \(Blender Guru\)](#)



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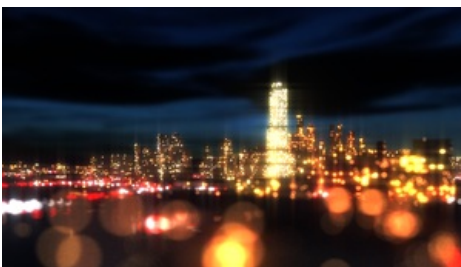
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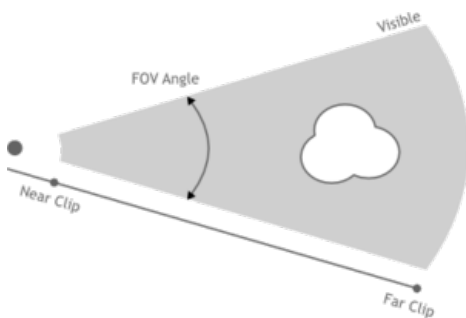
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Camera

Perspective

Lens Size and Angle

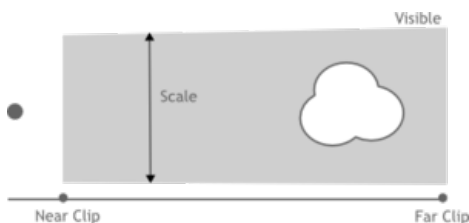
Control the field of view angle.



Orthographic

Scale

Controls the size of objects projected on the image.



Panoramic

Cycles supports Equirectangular and Fisheye panoramic cameras. Note that these can't be displayed with OpenGL rendering in the viewport, they will only work for rendering.

Equirectangular

Render a panoramic view of the scenes from the camera location and use an equirectangular projection, always rendering the full 360° over the X-axis and 180° over the Y-axis.

This projection is compatible with the environment texture as used for world shaders, so it can be used to render an environment map. To match the default mapping, set the camera object rotation to (90, 0, -90) or pointing along the positive X-axis. This corresponds to looking at the center of the image using the default environment texture mapping.

Fisheye

Fisheye lenses are typically wide angle lenses with a strong distortion, useful for creating panoramic images for e.g. dome projection, or as an artistic effect. The Fisheye Equisolid lens will best match real cameras. It provides a lens focal length and field of view angle, and will also take the sensor dimensions into account.

The Fisheye Equidistant lens does not correspond to any real lens model, it will give a circular fisheye that doesn't take any sensor information into account but rather uses the whole sensor. This is a good lens for full dome projection.

Lens

Lens focal length in millimeter.

Field of View

Field of view angle, going to 360 and more to capture the whole environment.

Depth of Field

Aperture Type

Method with which to specify the size of the camera opening through which light enters. With Radius the radius of the opening can be specified, while F/Stop specifies the size relative to the camera focal length, a measure more common photography.

Their relation is: $aperture\ radius = focal\ length / (2\ f-stop)$

Aperture Size

Also called lens radius. If this is zero, all objects will appear in focus, while larger values will make objects away from the focal distance appear out of focus.

Aperture F/Stop

Also called F-number or relative aperture. Lower numbers give more depth of field, higher numbers give a sharper image.

Aperture Blades

If this setting is 3 or more, a polygonal shaped aperture will be used instead of a circle, which will affect the shape of out of focus highlights in the rendered image.

Aperture Rotation

Rotation of the Aperture Blades.

Focal Distance

Distance at which objects are in perfect focus. Alternatively, an object can be specified whose distance from the camera will be used.

Clipping

Clip Start and End

The interval in which objects are directly visible. Any objects outside this range still influence the image indirectly, as further light bounces are not clipped. For OpenGL rendering, setting clipping distances to limited values is important to ensure sufficient rasterization precision. Raytracing does not suffer from this issue much, and as such more extreme values can safely be set.

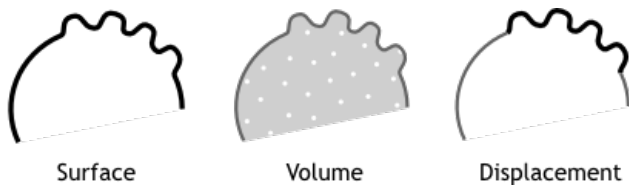
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Materials

Materials define the appearance of meshes, curves and other objects. They consist of three shaders, defining the appearance of the surface of the mesh, the volume inside the mesh, and displacement of the surface of the mesh.



Surface Shader

The surface shader defines the light interaction at the surface of the mesh. One or more BSDF's specify if incoming light is reflected back, refracted into the mesh or absorbed.

Emission defines how light is emitted from the surface, allowing any surface to become a light source.

Volume Shader

The volume shader is currently under independent development.

When the surface shader does not reflect or absorb light, it enters into the volume. If no volume shader is specified, it will pass straight through to the other side of the mesh.

If it is defined, a volume shader describes the light interaction as it passes through the volume of the mesh. Light may be scattered, absorbed, or emitted at any point in the volume.

A material may have both a surface and a volume shader, or only one of either. Using both may be useful for materials such as glass, water or ice, where you want some of the light to be absorbed as it passes through the surface, combined with e.g. a glass or glossy shader at the surface.

Displacement

The shape of the surface and the volume inside it may be altered by the displacement shaders. This way, textures can then be used to make the mesh surface more detailed.

Depending on the settings, the displacement may be virtual, only modifying the surface normals to give the impression of displacement, known as bump mapping, or a combination of real and virtual displacement.

Energy Conservation

The material system is built with physically based rendering in mind, cleanly separating how a materials looks and which rendering algorithms is used to render it. This makes it easier to achieve realistic results and balanced lighting, though there are a few things to keep in mind.

In order for materials to work well with global illumination, they should be, speaking in terms of physics, energy conserving. That means they can not reflect more light than comes in. This property is not strictly enforced, but if colors are in the range 0.0 to 1.0, and BSDF's are only mixed together with the Mix Shader node, this will automatically be true.

It is however possible to break this, with color values higher than 1.0 or using the Add Shader node, but one must be careful when doing this to keep materials behaving predictable under various lighting conditions. It can result in a reflection adding light into the system at each bounce, turning a BSDF into a kind of emitter.

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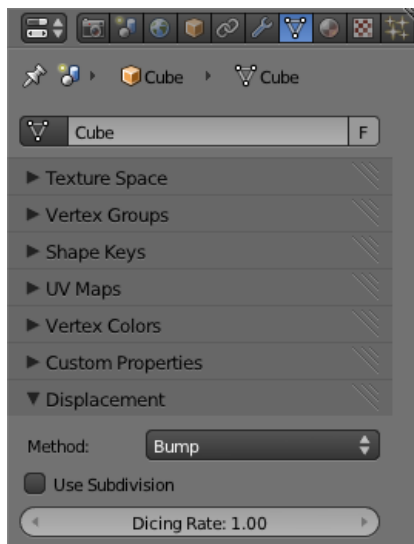
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Displacement

Implementation not finished yet, marked as [experimental feature](#).

The shape of the surface and the volume inside its mesh may be altered by the displacement shaders. This way, textures can then be used to make the mesh surface more detailed.

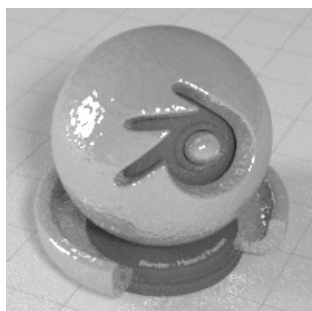
Type



Depending on the settings, the displacement may be virtual, only modifying the surface normals to give the impression of displacement, known as bump mapping, or a combination of real and virtual displacement. The displacement type options are:

- **True Displacement:** Mesh vertices will be displaced before rendering, modifying the actual mesh. This gives the best quality results, if the mesh is finely subdivided. As a result this method is also the most memory intensive.
- **Bump Mapping:** When executing the surface shader, a modified surface normal is used instead of the true normal. This is a quick alternative to true displacement, but only an approximation. Surface silhouettes will not be accurate and there will be no self shadowing of the displacement.
- **Displacement + Bump:** Both methods can be combined, to do displacement on a coarser mesh, and use bump mapping for the final details.

Subdivision



Bump Mapped
Displacement

Implementation not finished yet, marked as [experimental feature](#).

For detailed displacement, the mesh must be subdivided into small polygons. This can be achieved by adding a Subdivision Surface modifier, but it is also possible to let the render engine subdivide the mesh.

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Surface

The surface shader defines the light interaction at the surface of the mesh. One or more BSDF's specify if incoming light is reflected back, refracted into the mesh or absorbed.

Emission defines how light is emitted from the surface, allowing any surface to become a light source.

Terminology

- **BSDF** stands for bidirectional scattering distribution function. It defines how light is reflected and refracted at a surface.
- **Reflection** BSDF's reflect an incoming on the same side of the surface.
- **Transmission** BSDF's transmit an incoming ray through the surface, leaving on the other side.
- **Refraction** BSDF's are a type of **Transmission**, transmitting an incoming ray and changing it's direction as it exits on the other side of the surface.

BSDF Parameters

A major difference with non physically based renderers, is that direct light reflection from lamps, and indirect light reflection of other surfaces are not decoupled, but rather handled using a single BSDF. This limits the possibilities a bit, but we believe overall it is helpful in creating consistent looking renders with fewer parameters to tune.

For glossy BSDF's, **roughness** parameters control the sharpness of the reflection, from 0.0 perfectly sharp to 1.0 very soft. Compared to **hardness** or **exponent** parameters, it has the advantage of being in range 0.0..1.0, and as a result gives a more linear control and is more easily textureable. The relation is roughly: $roughness = 1 - 1/hardness$

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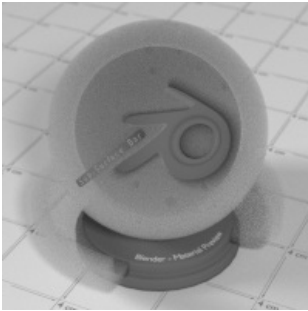
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The Volume Shader

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Texture Editing

3D viewport draw types, UV mapping, texture painting work somewhat different when Cycles is enabled. UV Maps no longer get image textures assigned themselves, rather they must always be assigned by adding an image texture node.

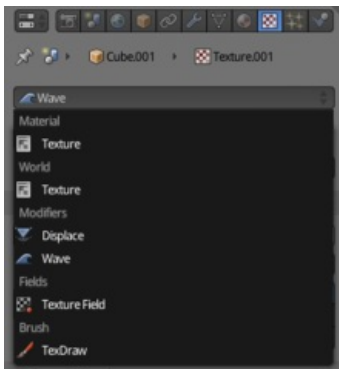
3D Viewport Draw Types

The Texture draw type for Blender Internal has been replaced by three others:

- *Texture*: this draw mode would be used for editing, painting and mapping individual textures. Lighting is the same as solid, so this is similar to the existing textured solid for Blender Internal. The texture drawn is the active image texture node in the material.
- *Material*: a simplified version of the entire material is drawn using GLSL shaders. This uses solid lighting, and also is mostly useful for editing, painting and mapping textures, but while seeing how they integrate with the material.
- *Rendered*: in this draw mode the render engine will do the drawing, interactively refining the full rendered image by taking more samples. Unlike offline rendering, objects will still use viewport rather than render resolution and visibility.



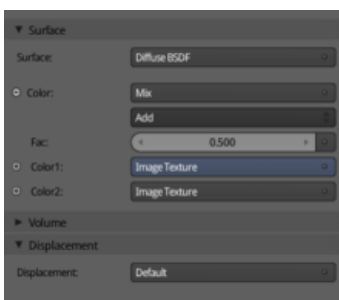
Texture Properties



In the texture properties, the texture can now be selected from a list, that contains all textures nodes from the world, lamps and materials, but also from e.g. modifiers, brushes and physics fields.

For shading nodes, the available textures are Cycles textures. For others, Blender textures are still used, but this will change in the future.

Painting & UV Editing



For texture paint mode, the image that is painted on is taken from the active image texture node. This can be selected in the node editor or the texture properties, and it is indicated as blue in the material properties.

For UV mapping, the active UV map as specified in the mesh properties is used. Assigning images in the image editor also affects the active image texture node.

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World

The world environment can emit light, ranging from a single solid color, physical sky model, to arbitrary textures.

Surface Shader

The surface shader defines the light emission from the environment into the scene. The world surface is rendered as if it is very distant from the scene, and as such there is no two-way interacting between objects in the scene and the environment, only light coming in. The only shader accepted is the Background node with a color input and strength factor for the intensity of the light.

Volume Shader

Under independent development

Ambient Occlusion

Ambient occlusion is a lighting method, based on how much a point on a surface is occluded by nearby surfaces. This is a trick that is not physically accurate, but it is useful to emphasize shapes of surfaces, or as a cheap way to get an effect that looks a bit like indirect lighting.

- Factor: The strength of the ambient occlusion, value 1.0 is like a white world shader.
- Distance: Distance from shading point to trace rays. Shorter distance emphasizes nearby features, longer distance makes it also take objects further away into account.

Lighting from ambient occlusion is only applied to diffuse reflection BSDFs, glossy or transmission BSDFs are not affected. Transparency of surfaces will be taken into account, i.e. a half transparent surface will only half occlude.

Tricks

Sometimes it may be useful to have a different background that is directly visible versus one that is indirectly lighting the objects. A simple solution to this is to add a Mix node, with the Blend Factor set to Is Camera Ray. The first input color is then the indirect color, and the second the directly visible color.

Background shaders are currently not importance sampled, that means they don't use more samples on regions of the background that are brighter. This in turn can lead to slow convergence with for example textures that have a few bright spots. Blurring such textures may reduce noise and converge faster.

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Lamps

Next to lighting from the background and any object with an emission shader, lamps are another way to add light into the scene. The difference is that they are not directly visible in the rendered image, and can be more easily managed as objects of their own type.

Type

Currently **Point**, **Spot**, **Area** and **Sun** lamps are supported. Hemi lamps are not supported, and will be rendered as point and sun lamps respectively, but they may start working in the future, so it's best not to enable them to preserve compatibility.

Size

Size of the lamp in blender units, increasing this will result in softer shadow and shading.

Cast Shadow

By disabling this option, light from lamps will not be blocked by objects in between. This can speed up rendering by not having to trace rays to the light source.

Point Lamp

Point lamps emit light equally in all directions. By setting the Size larger than zero, they become spherical lamps, which give softer shadows and shading. The strength of point lamps is specified in Watts.

Spot Lamp

Spot lamps emit light in a particular direction, inside a cone. By setting the Size larger than zero, they can get softer shadows and shading. The size parameter defines the size of the cone, while the blend parameter can soften the edges of the cone.

Area Lamp

Area lamps emit light from a square or rectangular area with a Lambertian distribution.

Sun Lamp

Sun lamps emit lights in a given direction. Their position is not taken into account, they are always located outside of the scene, infinitely far away, and will not result in any distance falloff.

Because they are not located inside the scene, their strength uses different units, and should typically be set to lower values than other lights.

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Nodes

Materials, lights and backgrounds are all defined using a network of shading nodes. These nodes output values, vectors, colors and shaders.

Shaders

An important concept to understand when building node setups is that of the **shader socket**. The output of all surface and volume shaders is a shader, describing lighting interaction at the surface or volume, rather than the color of the surface.

There are a few types of shaders available as nodes:

- **BSDF** shader describing light reflection, refraction and absorption at an object surface.
- **Emission** shader describing light emission at an object surface or in a volume.
- **Volume** shader describing light scattering inside a volume.
- **Background** shader describing light emission from the environment

Each shader node has a color input and outputs a shader. These can then be mixed and added together using Mix and Add Shader nodes. No other operations are permitted. The resulting output can then be used by the render engine to compute all light interactions, for direct lighting or global illumination.

Textures

Each texture type in Cycles corresponds to a node, with a texture coordinate and various parameters as input, and a color or value as output. No texture datablocks are needed, instead node groups can be used for reusing texture setups.

For UV mapping and texture painting in the viewport, the Image texture node must be used. When setting such a node as active, it will be drawn in Textured draw mode, and can be painted on in texture paint mode.

The default texture coordinate for all nodes is Generated coordinates, with the exception of Image textures that use UV coordinates by default. Each node includes some options to modify the texture mapping and resulting color, and these can be edited in the texture properties.

More

Nodes for geometric data, texture coordinates, layering shaders and non-physically based tricks.

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Shader Nodes

BSDF

Diffuse

Lambertian and Oren-Nayar diffuse reflection.

Color input

Color of the surface, or physically speaking, the probability that light is reflected or transmitted for each wavelength.

Roughness input

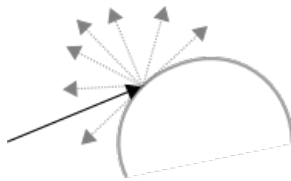
Surface roughness 0.0 gives standard Lambertian reflection, higher values activate the Oren-Nayar BSDF.

Normal input

Normal used for shading, if nothing is connected the default shading normal will be used.

BSDF output

Diffuse BSDF shader.



Diffuse behaviour



Lambertian Diffuse



Oren Nayar Diffuse

Translucent

Lambertian diffuse transmission.

Color input

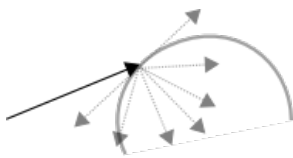
Color of the surface, or physically speaking, the probability that light is transmitted for each wavelength.

Normal input

Normal used for shading, if nothing is connected the default shading normal will be used.

BSDF output

Translucent BSDF shader.



Translucent Shader

Glossy

Glossy reflection with microfacet distribution, used for materials such as metal or mirrors. Glossy tends to produce many fireflies.

Distribution

Microfacet distribution to use. Sharp results in perfectly sharp reflections like a mirror, while Beckmann and GGX can use the Roughness input for blurry reflections.

Color input

Color of the surface, or physically speaking, the probability that light is reflected for each wavelength.

Roughness input

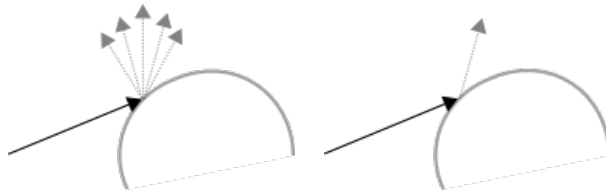
Influences sharpness of the reflection, perfectly sharp at 0.0 and smoother with higher values.

Normal input

Normal used for shading, if nothing is connected the default shading normal will be used.

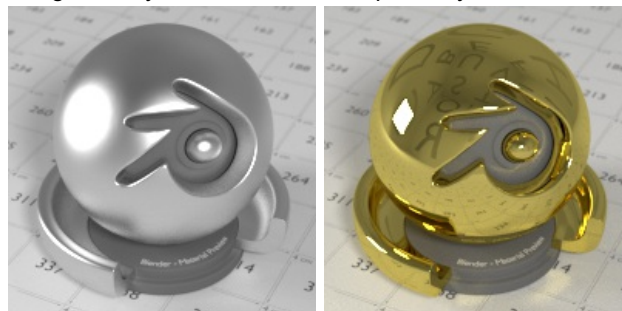
BSDF output

Glossy BSDF shader.



Rough Glossy behaviour

Sharp Glossy behaviour



A Rough Glossy Material

A Sharp Glossy Material

Anisotropic

Anisotropic glossy reflection, with separate control over U and V direction roughness. The tangent used for shading is derived from the active UV map. If no UV map is available, they are automatically generated using on a sphere mapping based on the mesh bounding box.

Color input

Color of the surface, or physically speaking, the probability that light is reflected for each wavelength.

Roughness U input

Influences sharpness of the reflection along the U direction of the tangent, perfectly sharp at 0.0 and smoother with higher values.

Roughness V input

Same as Roughness U, but for the V direction along the tangent.

Normal input

Normal used for shading, if nothing is connected the default shading normal will be used.

Tangent input

Tangent used for shading, if nothing is connected the default shading tangent will be used.

BSDF output

Anisotropic glossy BSDF shader.

Transparent

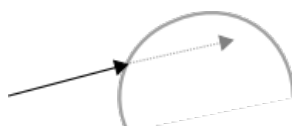
Transparent BSDF without refraction, passing straight through the surface, as if there was no geometry there. Useful with alpha maps for example. This shader [affects light paths somewhat differently](#) than other BSDF's. Note that only pure white transparent shaders are completely transparent.

Color input

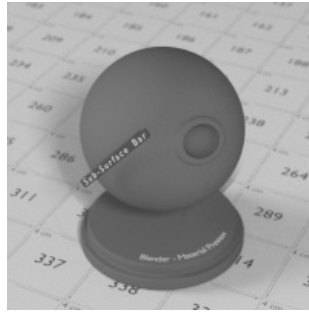
Color of the surface, or physically speaking, the probability for each wavelength that light is blocked or passes straight through the surface.

BSDF output

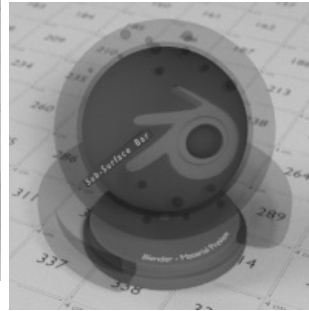
Transparent BSDF shader.



Transparent behaviour



Transparent Shader (pure white)



Transparent Shader (grey)

Glass

Glass like shader mixing refraction and reflection at grazing angles. Like the transparent shader, only pure white will make it transparent. The glass shader tends to cause noise due to caustics. Since the Cycles path tracing integrator is not very good at rendering caustics, it helps to combine this with a transparent shader for shadows, for [more details see here](#).

Distribution

Microfacet distribution to use. Sharp results in perfectly sharp refractions like clear glass, while Beckmann and GGX can use the Roughness input for rough glass.

Color input

Color of the surface, or physically speaking, the probability that light is transmitted for each wavelength.

Roughness input

Influences sharpness of the refraction, perfectly sharp at 0.0 and smoother with higher values.

IOR input

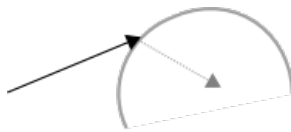
Index of refraction defining how much the ray changes direction. At 1.0 rays pass straight through like transparent, higher values give more refraction.

Normal input

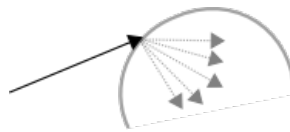
Normal used for shading, if nothing is connected the default shading normal will be used.

BSDF output

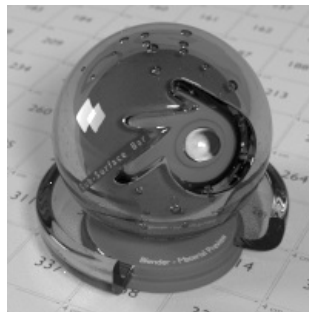
Glass BSDF shader.



Sharp Glass behaviour



Rough Glass behaviour



A Sharp Glass Material



A Rough Glass Material

Velvet

Velvet reflection shader for materials such as cloth.

Color input

Color of the surface, or physically speaking, the probability that light is reflected for each wavelength.

Sigma input

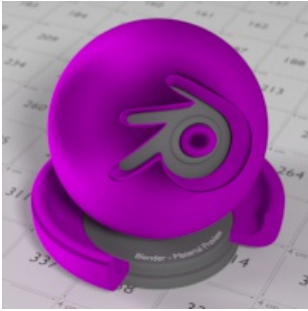
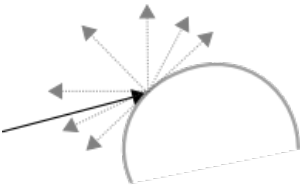
no description yet

Normal input

Normal used for shading, if nothing is connected the default shading normal will be used.

BSDF output

Velvet BSDF shader.



The Velvet Shader

Emission

Lambertian emission, to be used for the material and lamp surface outputs.

Color input

Color of the emitted light.

Strength input

Strength of the emitted light. For point and area lamps the unit is Watts. For materials a value of 1.0 will ensure the object in the image will have the exact same color as the Color input, i.e. make it 'shadeless'.

Normal input

Normal used for shading, if nothing is connected the default shading normal will be used.

Emission output

Emission shader.



An Emissive material, with brightness 1.

Background

Background light emission. This node should only be used for the world surface output, it will be ignored in other cases.

Color input

Color of the emitted light.

Strength input

Strength of the emitted light.

Background output

Background shader.

Holdout

A holdout shader is useful for compositing, to create a "hole" in the image with zero alpha transparency where the object with this shader is located.

Holdout output

Holdout shader.



The black area is a region with zero Alpha.

Mix and Add

Mix or add shaders together. Mixing can be used for material layering, where the Fac input may for example be connected to a Blend Weight node.

Shader inputs

Shaders to mix, such that incoming rays hit either with the specified probability in the Fac socket.

Fac input

Blend weight to use for mixing two shaders, at zero it uses the first shader entirely and at one the second shader.

Shader output

Mixed shader.



A mix of a glossy and a diffuse shader makes a nice ceramic material.

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Texture Nodes

Image Texture

Use image file as texture.

Image Datablock

Image datablock used as image source. Currently not all images supported by Blender can be used by Cycles. In particular generated, packed images or animations are not supported currently.

Projection

Projection to use for mapping the textures. Flat will use the XY coordinates for mapping. Box will map the image to the 6 sides of a virtual box, based on the normal, using XY, YZ and XYZ coordinates depending on the side.

Projection Blend

For Box mapping, the amount to blend between sides of the box, to get rid of sharp transitions between the different sides.

Blending is useful to map a procedural like image texture pattern seamlessly on a model. 0.0 gives no blending, higher values give a smoother transition.

Color Space

Type of data that the image contains, either Color or Non-Color Data. For most color textures the default of Color should be used, but in case of e.g. a bump or alpha map, the pixel values should be interpreted as Non-Color Data, to avoid doing any unwanted color space conversions.

Vector input

Texture coordinate for texture lookup. If this socket is left unconnected, UV coordinates from the active UV render layer will be used.

Color output

RGB color from image.

Environment Texture

Use environment map image file as texture. The environment map is expected to be in Latitude/Longitude or 'latlong' format.

Image Datablock

Image datablock used as image source. Currently not all images supported by Blender can be used by Cycles. In particular generated, packed images or animations are not supported currently.

Color Space

Type of data that the image contains, either Color or Non-Color Data. For most color textures the default of Color should be used, but in case of e.g. a bump or alpha map, the pixel values should be interpreted as Non-Color Data, to avoid doing any unwanted color space conversions.

Vector input

Texture coordinate for texture lookup. If this socket is left unconnected, the image will be mapped as environment with the Z axis as up.

Color output

RGB color from image.

Sky Texture

Procedural sun-sky texture.

Sun Direction

Sun direction vector.

Turbidity

Cloudiness of the sky.

Vector

Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.

Color output

Texture color output.

Noise Texture

Procedural perlin noise texture, similar to the Clouds texture in Blender Internal.

Vector input

Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.

Scale input

Overall texture scale.

Detail input

Amount of noise detail.

Distortion input

Amount of distortion.
Color output
Texture color output.
Fac output
Texture intensity output.

Wave Texture

Procedural bands or rings texture with noise distortion.

Type
Bands or Rings shaped waves.
Vector input
Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.
Scale input
Overall texture scale.
Detail input
Amount of noise detail.
Distortion input
Amount of distortion.
Color output
Texture color output.
Fac output
Texture intensity output.

Voronoi Texture

Procedural texture producing Voronoi cells.

Type
Intensity or Cells output.
Vector input
Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.
Scale input
Overall texture scale.
Color output
Texture color output.
Fac output
Texture intensity output.

Musgrave Texture

Advanced procedural noise texture.

Type
Multifractal, Ridged Multifractal, Hybrid Multifractal, fBM, Hetero Terrain.
Vector input
Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.
Scale input
Overall texture scale.
Detail input
Amount of noise detail.
Dimension input
TBD
Lacunarity input
TBD
Offset input
TBD
Gain input
TBD
Color output
Texture color output.
Fac output
Texture intensity output.

Gradient Texture

A gradient texture.

Type

The gradient could be Linear, Quadratic, Easing, Diagonal, Spherical, Quadratic Sphere or Radial.

Vector input

Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.

Color output

Texture color output.

Fac output

Texture intensity output.

Magic Texture

Psychedelic color texture.

Depth

Number of iterations.

Vector input

Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.

Distortion input

Amount of distortion.

Color output

Texture color output.

Fac output

Texture intensity output.

Checker Texture

Checkerboard texture.

Vector input

Texture coordinate to sample texture at, defaults to Generated texture coordinates if the socket is left unconnected.

Color1/2 input

Color of checkers.

Scale input

Overall texture scale.

Color output

Texture color output.

Fac output

Checker 1 mask (1 = Checker 1).

Brick Texture

Procedural texture producing Bricks.

Options

Offset

Determines the brick offset of the various rows.

Frequency

Determines the offset frequency. A value of 2 gives a even/uneven pattern of rows.

Squash

Amount of brick squashing.

Frequency

Brick squashing frequency.

Sockets

Color 1/2 and Mortar

Color of the bricks and mortar.

Scale

Overall texture scale.

Mortar Size

The Mortar size, 0 means no Mortar.

Bias

The color variation between Brick color 1 / 2. Values of -1 and 1 only use one of the two colors, values in between mix the colors.

Brick Width

The width of the bricks.

Row Height

The height of the brick rows.

Color output

Texture color output.

Fac output

Mortar mask (1 = mortar).

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More Nodes

Value

Input a scalar value.

Value
Value output.

RGB

Input an RGB color.

Color
RGB color output.

Geometry

Geometric information about the current shading point. All vector coordinates are in *World Space*. For volume shaders, only the position and incoming vector are available.

Position
Position of the shading point.

Normal
Shading normal at the surface (includes smooth normals and bump mapping).

Tangent
Tangent at the surface.

True Normal
Geometry or flat normal of the surface.

Incoming
Vector pointing towards the point the shading point is being viewed from.

Parametric
Parametric coordinates of the shading point on the surface.

Backfacing
1.0 if the face is being viewed from the backside, 0.0 for the frontside.

Texture Coordinates

Commonly used texture coordinates, typically used as inputs for the Vector input for texture nodes

Generated
Automatically generated texture coordinates from the vertex positions of the mesh without deformation, keeping them sticking to the surface under animation. Range from 0.0 to 1.0 over the bounding box of the undeformed mesh.

Normal
Object space normal, for texturing objects with the texture staying fixed on the object as it transformed.

UV
UV texture coordinates from the active render UV layer.

Object
Position coordinate in object space.

Camera
Position coordinate in camera space.

Window
Location of shading point on the screen, ranging from 0.0 to 1.0 from the left to right side and bottom to top of the render.

Reflection
Vector in the direction of a sharp reflection, typically used for environment maps.

Bump

Generate a perturbed normal from a height texture, for bump mapping. The height value will be sampled at the shading point and two nearby points on the surface to determine the local direction of the normal.

Strength
Strength of the bump mapping effect.

Height
Scalar value giving the height offset from the surface at the shading point.

Object Info

Information about the object instance. This can be useful to give some variation to a single material assigned to multiple instances, either manually controlled through the object index, based on the object location, or randomized for each instance. For example a Noise texture can give random colors or a Color ramp can give a range of colors to be randomly picked from.

Location

Location of the object in world space.

Object Index

Object pass index, same as in the Object Index pass.transformed.

Material Index

Material pass index, same as in the Material Index pass.

Random

Random number unique to a single object instance.

Particle Info

For objects instanced from a particle system, this nodes give access to data of the particle that spawned the instance.

Index

index number of the particle (from 0 to number of particles).

Age

age of the particle in frames.

Lifetime

total life span of the particle in frames.

Location

location of the particle.

Size

size of the particle.

Velocity

velocity of the particle.

Angular Velocity

angular velocity of the particle.

Attribute

Retrieve attribute attached to the object or mesh. Currently UV maps and vertex color layers can be retrieved this way by their names, with layers and attributes planned to be added. Also internal attributes like P (position), N (normal), Ng (geometric normal) may be accessed this way, although there are more convenient nodes for this.

Name

Name of the attribute.

Color output

RGB color interpolated from the attribute.

Vector output

XYZ vector interpolated from the attribute.

Fac output

Scalar value interpolated from the attribute.

Mapping

Transform a coordinate, typically used for modifying texture coordinates.

Location

Vector translation.

Rotation

Rotation of the vector along XYZ axes.

Scale

Scale the vector.

Vector input

Vector to be transformed.

Vector output

Transformed vector.

Layer Weight

Output weights typically used for layering shaders with the Mix Shader node.

Blend input

Blend between the first and second shader.

Fresnel output

Dielectric fresnel weight, useful for example to layer a diffuse and glossy shader to create a plastic material. This is like the Fresnel node, except that the input of this node is in the often more convenient 0.0 to 1.0 range.

Facing output

Weight that blends from the first to the second shader as the surface goes from facing the viewer to viewing it at a grazing angle.

Fresnel

Dielectric fresnel, computing how much light is refracted through and how much is reflected off a layer. The resulting weight can be used for layering shaders with the Mix Shader node. It is dependent on the angle between the surface normal and the viewing direction.

IOR input

Index of refraction of the material being entered.

Fresnel output

Fresnel weight, indicating the probability with which light will reflect off the layer rather than passing through.

Light Path

Node to find out for which kind of ray the shader is being executed, particularly useful for non-physically based tricks. More information about the meaning of each type is in the [Light Paths](#) documentation.

Is Camera Ray output

1.0 if shading is executed for a camera ray, 0.0 otherwise.

Is Shadow Ray output

1.0 if shading is executed for a shadow ray, 0.0 otherwise.

Is Diffuse Ray output

1.0 if shading is executed for a diffuse ray, 0.0 otherwise.

Is Glossy Ray output

1.0 if shading is executed for a glossy ray, 0.0 otherwise.

Is Singular Ray output

1.0 if shading is executed for a singular ray, 0.0 otherwise.

Is Reflection Ray output

1.0 if shading is executed for a reflection ray, 0.0 otherwise.

Is Transmission Ray output

1.0 if shading is executed for a transmission ray, 0.0 otherwise.

Ray Length output

Distance traveled by the light ray from the last bounce or camera.

Light Falloff

Manipulate how light intensity decreases over distance. In reality light will always falloff quadratically, however it can be useful to manipulate as a non-physically based lighting tricks. Note that using Linear or Constant falloff may cause more light to be introduced with every global illumination bounce, making the resulting image extremely bright if many bounces are used.

Strength input

Light strength before applying falloff modification.

Smooth input

Smooth intensity of light near light sources. This can avoid harsh highlights, and reduce global illumination noise. 0.0 corresponds to no smoothing, higher values smooth more. The maximum light strength will be strength/smooth

Quadratic output

Quadratic light falloff, this will leave strength unmodified if smooth is 0.0 and corresponds to reality.

Linear output

Linear light falloff, giving a slower decrease in intensity over distance.

Constant output

Constant light falloff, where the distance to the light has no influence on its intensity.

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Light Paths

Ray Types

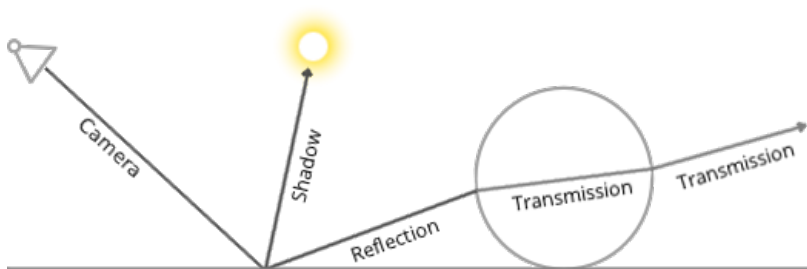
Ray types can be divided in four categories:

- Camera: ray comes straight from the camera
- Reflection: ray is generated by a reflection off a surface
- Transmission: ray is generated by a transmission through a surface
- Shadow: ray is used for (transparent) shadows

Reflection and transmission rays can further have these properties:

- Diffuse: ray is generated by a diffuse reflection or transmission (translucency)
- Glossy: ray is generated by a glossy specular reflection or transmission
- Singular: ray is generated by a perfectly sharp reflection or transmission

The Light Path node can be used to find out the type of ray the shading is being computed for.



Bounce Control

The maximum number of light bounces can be controlled manually. While ideally this should be infinite, in practice a smaller number of bounces may be sufficient, or some light interactions may be intentionally left out for faster convergence. The number of diffuse reflection, glossy reflection and transmission bounces can also be controlled individually.

Lights paths will be terminated probabilistically when specifying a minimum number of light bounces lower than the maximum. In that case paths longer than minimum will be randomly stopped when they are expected to contribute less light to the image. This will still converge to the same image, but renders faster while possibly being noisier.

A common source of noise are caustics, which are diffuse bounces followed by a glossy bounce (assuming we start from the camera). An option is available to disable these entirely.

Transparency

The transparent BSDF shader is given special treatment. When a ray passes through it, light passes straight on, as if there was no geometry there. The ray type does not change when passing through a transparent BSDF.

Alpha pass output is also different for the transparent BSDF. Other transmission BSDF's are considered opaque, because they change the light direction. As such they can't be used for alpha over compositing, while this is possible with the transparent BSDF.

The maximum number of transparent bounces is controlled separately from other bounces. It is also possible to use probabilistic termination of transparent bounces, which might help rendering many layers of transparency.

Note that while semantically the ray passes through as if no geometry was hit, rendering performance is affected as each transparency step requires executing the shader and tracing a ray.

Ray Visibility

Objects can be set to be invisible to particular ray types:

- Camera
- Diffuse reflection
- Glossy reflection
- Transmission
- Shadow

This can be used for example to make an emitting mesh invisible from camera rays. For duplicators visibility is inherited, if the parent

object is hidden for some ray types, the children will be hidden for these too.

In terms of performance, using these options is more efficient than using a shader node setup that achieves the same effect. Objects invisible to a certain ray will be skipped in ray traversal already, leading to fewer rays cast and shaders executed.

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Integrator

The integrator is the rendering algorithm used to compute the lighting. Cycles currently supports a path tracing integrator with direct light sampling. It works well for various lighting setups, but is not as suitable for caustics and some other complex lighting situations.

Rays are traced from the camera into the scene, bouncing around until they find a light source such as a lamp, an object emitting light, or the world background. To find lamps and surfaces emitting light, both indirect light sampling (letting the ray follow the surface BSDF) and direct light sampling (picking a light source and tracing a ray towards it) are used.

Scene Settings

Sampling

There are two integrator modes that can be used, progressive and non-progressive. The **progressive integrator** is a pure path trace, at each hit it will bounce light in one direction and pick one light to receive lighting from. This makes each individual sample faster to compute, but will typically require more samples to clean up the noise.

Render Samples

Number of paths to trace for each pixel in the final render. As more samples are taken, the solution becomes less noisy and more accurate.

Preview Samples

Number of samples for viewport rendering.

The **non-progressive integrator** is similar, but at the first hit it can do multiple light bounces and will take all lights into account for shading instead of just one. This makes each sample slower, but will reduce noise especially in scenes dominated by direct or one bounce lighting. To get the same number of diffuse samples as in the progressive integrator, note that e.g. 250 progressive samples = 10 AA samples x 25 diffuse samples.

AA Render Samples

Number of samples to take for each pixel in the final render. More samples will improve antialiasing.

AA Preview Samples

Number of samples for viewport rendering.

Diffuse Samples

Number of diffuse bounce samples to take for each AA sample.

Glossy Samples

Number of glossy bounce samples to take for each AA sample.

Transmission Samples

Number of transmission bounce samples to take for each AA sample.

AO Samples

Number of ambient occlusion samples to take for each AA sample.

Mesh Light Samples

Number of mesh light samples to take for each AA sample.

For both integrators the noise pattern can be controlled.

Seed

Random number generator seed, each different value gives a different noise pattern.

Bounces

Max Bounces

Maximum number of light bounces. For best quality, this should be set to the maximum. However in practice, it may be good to set it to lower values for faster rendering. Setting it to maximum 1 bounces results in direct lighting.

Min Bounces

Minimum number of light bounces for each path, after which the integrator uses russian roulette to terminate paths that contribute less to the image. Setting this higher gives less noise, but may also increase render time considerably.

Diffuse Bounces

Maximum number of diffuse bounces.

Glossy Bounces

Maximum number of glossy bounces.

Transmission Bounces

Maximum number of transmission bounces.

Transparency

Transparency Max

Maximum number of transparency bounces.

Transparency Min

Minimum number of transparency bounces, after which russian roulette termination is used.

Transparent Shadows

For direct light sampling, use transparency of surfaces inbetween to produce shadows affected by transparency of those surfaces.

Tricks

No Caustics

While in principle path tracing supports rendering of caustics with a sufficient number of samples, in practice it may be inefficient to the point that there is just too much noise. This options makes it possible to disable them entirely.

Filter Glossy

When using a value higher than 0.0, this will blur glossy reflections after blurry bounces, to reduce noise at the cost of accuracy. 1.0 is a good starting value to tweak.

Some light paths have a low probability of being found while contributing much light to the pixel. As a result these light paths will be found in some pixels and not in others, causing fireflies. An example of such a difficult path might be a small light that is causing a small specular highlight on a sharp glossy material, which we are seeing through a rough glossy material. In fact in such a case we practically have a caustic.

With path tracing it is difficult to find the specular highlight, but if we increase the roughness on the material the highlight gets bigger and softer, and so easier to find. Often this blurring will be hardly noticeable, because we are seeing it through a blurry material anyway, but there are also cases where this will lead to a loss of detail in lighting.

Clamp Samples

This option will clamp all samples to a maximum intensity they can contribute to the pixel, again to reduce noise at the cost of accuracy. With value 0.0 this option is disabled, lower values clamp more light away.

If the image has fireflies, there will be samples that contribute very high values to pixels, and this is option provides a way to limit that. However note that as you clamp out such values, bright colors in other places where there is no noise will be lost as well. So this is a balance between reducing the noise and keeping the image from losing its intended bright colors.

Motion Blur

Camera and object motion blur rendering can be enabled per scene, and affects all render layers. This will take the camera and object motion into account to blur objects along a curve through the previous, current and next frame. Currently motion blur from deforming objects is not supported yet, only object transformations like translation, rotation and scaling. Viewport rendering currently will not show motion blur.

Shutter

Time between frames over which motion blur is computed. Shutter time 1.0 blurs over the length of 1 frame, 2.0 over the length of two frames, from the previous to the next.

Material Settings

Sample as Lamp

By default objects with emitting materials use both direct and indirect light sampling methods, but in some cases it may lead to less noise overall to disable direct light sampling for some materials. This can be done by disabling the Sample as Lamp option. This is especially useful on large objects that emit little light compared to other light sources.

World Settings

Sample as Lamp

By default lighting from the world is computed solely with indirect light sampling. However for more complex environment maps this can be too noisy, as sampling the BSDF may not easily find the highlights in the environment map image. By enabling this option, the world background will be sampled as a lamp, with lighter parts automatically given more samples.

Map Resolution

When Sample as Lamp is enabled, this specifies the size of the importance map (resolution x resolution). Before rendering starts, an importance map is generated by "baking" a grayscale image from the world shader. This will then be used to determine which parts of the background are light and so should receive more samples than darker parts. Higher resolutions will result in more accurate sampling but take more setup time and memory.

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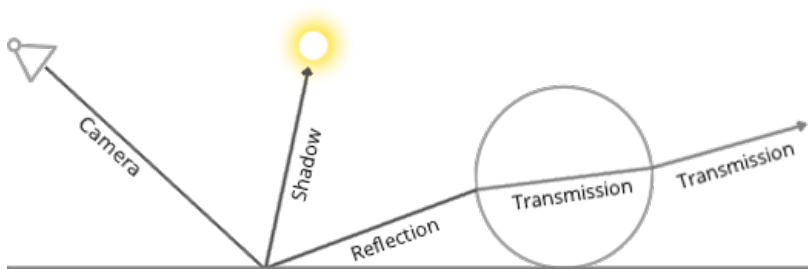
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Reducing Noise

When performing a final render, it is important to reduce noise as much as possible. Here we'll discuss a number of tricks that while breaking the laws of physics, are particularly important when rendering animations within a reasonable time. Click enlarge the example images to see the noise differences well.

Path Tracing

Cycles uses path tracing with next event estimation, which is not as good at rendering all types of light effects like caustics, but has the advantage of being able to render more detailed and larger scenes compared to some other rendering algorithms. This is because we do not need to store for example a photon map in memory, and because we can keep rays relatively coherent to use an on demand image cache, compared to e.g. bidirectional path tracing.

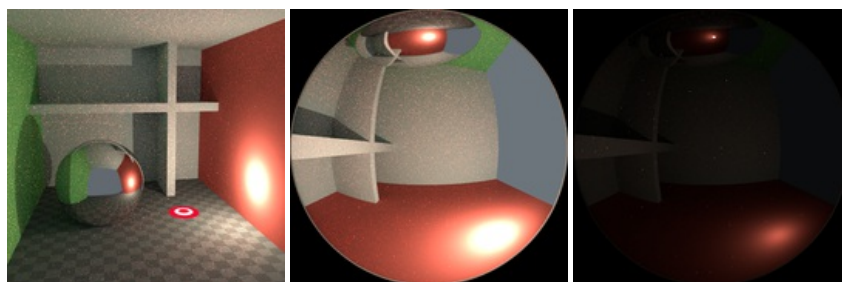


We do the inverse of what reality does, tracing light rays from the camera into the scene and onto lights, rather than from the light sources into the scene and then into the camera. This has the advantage that we do not waste light rays that will not end up on the camera, but also means that it is difficult to find some light paths that may contribute a lot. Light rays will be sent either according to the surface BRDF, or in the direction of known light sources (lamps, emitting meshes with Sample as Lamp).

For more details, see the [Light Paths](#) and [Integrator](#) documentation.

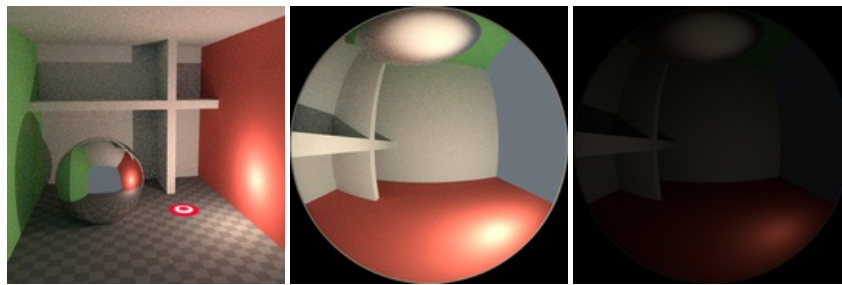
Where Noise Comes From

To understand where noise can come from, take for example this scene. When we trace a light ray into the specified location, this is what the diffuse shader "sees". To find the light that it is reflected from this surface, we need to find the average color from all these pixels. Note the glossy highlight on the sphere, and the bright spot the lamp casts on the nearby wall. These hotspots are 100x brighter than other parts of the image and will contribute significantly to the lighting of this pixel.



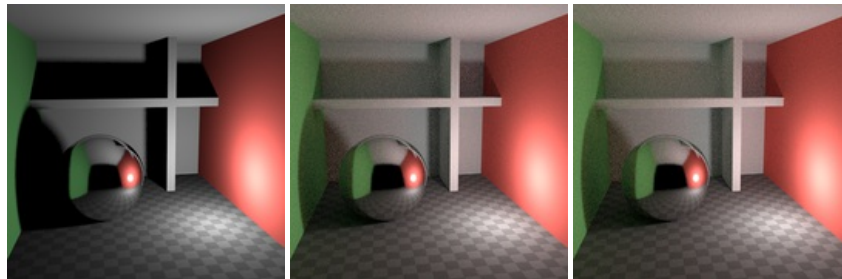
The lamp is a known light source, so it will not be too hard to find, but the glossy highlight(s) that it causes are a different matter. The best we can do with path tracing is to distribute light rays randomly over the hemisphere, hoping to find all the important bright spots. If for some pixels we miss some bright spot, but we do find it for another, that results in noise. The more samples we take, the higher the probability that we cover all the important sources of light.

With some tricks we can reduce this noise. If we blur the bright spots, they become bigger and less intense, making them easier to find and less noisy. This will not give the same exact result, but often it's close enough when viewed through a diffuse or soft glossy reflection. Below is an example of using Filter Glossy and Smooth Light Falloff.



Bounces

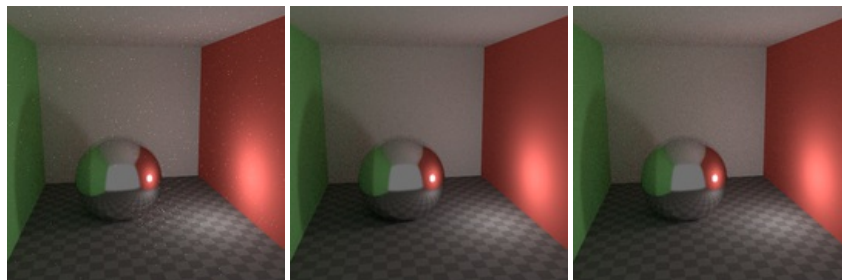
In reality light will bounce a huge number of times due to the speed of light being very high. In practice more bounces will introduce more noise, and it might be good to use something like the Limited Global Illumination preset that uses **fewer bounces for different shader types**. Diffuse surfaces typically can get away with fewer bounces, while glossy needs a few more, and transmission shaders such as glass usually need the most.



Also important is to **use shader colors that do not have components of value 1.0** or values near that, try to keep the maximum value to 0.8 or less and make your lights brighter. In reality surfaces are rarely perfectly reflecting all light, but there are of course exceptions, usually glass will let most light through, which is why we need more bounces there. High values for the color components tend to introduce noise because light intensity then does not decrease much as it bounces off each surface.

Caustics and Filter Glossy

Caustics are a well known source of noise causing fireflies. They happen because the renderer has difficulty finding specular highlights viewed through a soft glossy or diffuse reflection. There is a [No Caustics](#) option to disable glossy behind a diffuse reflection entirely. Many render engines will typically disable caustics by default.

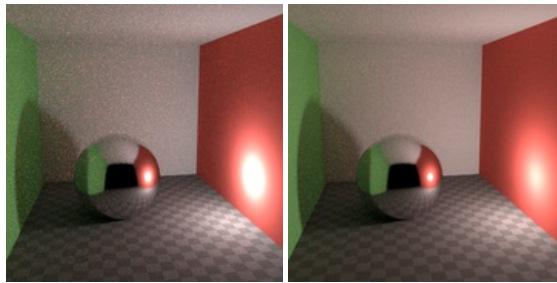


However using No Caustics will result in missing light, and it still does not cover the case where a sharp glossy reflection is viewed through a soft glossy reflection. There exists a [Filter Glossy](#) option to reduce the noise from such cases at the cost of accuracy. This will blur the sharp glossy reflection to make it easier to find, by increasing the shader Roughness.

The above images show default settings, no caustics, and filter glossy set to 1.0.

Light Falloff

In reality light in a vacuum will always falloff at a rate of $1/(\text{distance}^2)$. However as distance goes to zero, this value goes to infinity and we can get very bright spots in the image. These are mostly a problem for indirect lighting, where the probability of hitting such a small but extremely bright spot is low and so happens only rarely. This is a typical recipe for fireflies.

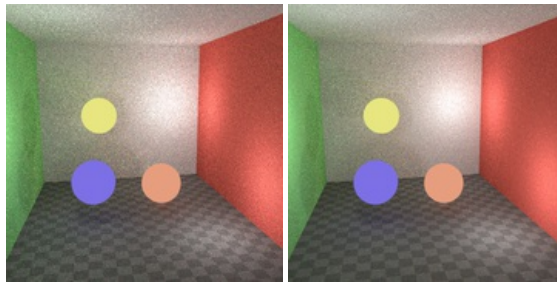


To reduce this problem, the [Light Falloff node](#) has a **Smooth factor**, that can be used to reduce the maximum intensity a light can contribute to a nearby surfaces. The images above show default falloff and smooth value 1.0.

Sample as Lamp

Materials with emission shaders can be configured to be [Sampled as a Lamp](#). This means that they will get rays sent directly towards them, rather than ending up there based on rays randomly bouncing around. For very bright mesh light sources this can reduce noise significantly. However when the emission is not particularly bright, this will take away samples from other brighter light sources for which it is important to find them this way.

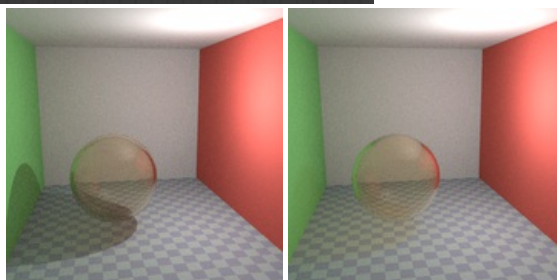
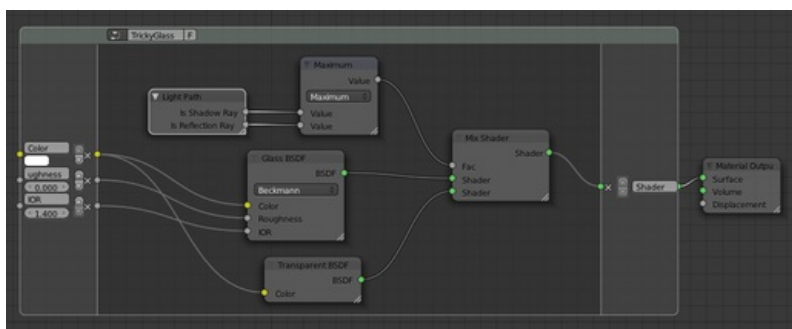
The optimal setting here is difficult to guess, it may be a matter of trial and error, but often it is clear that a somewhat glowing objects may be only contributing light locally, while a mesh light used as a lamp would need this option enabled. Here is an example where the emissive spheres contribute little to the lighting, and the image renders with slightly less noise by disabling Sample as Lamp on them.



The world background also has a [Sample as Lamp](#) option. This is mostly useful for environment maps that have small bright spots in them, rather than being smooth. This option will then in a preprocess determine the bright spots, and send light rays directly towards them. Again, enabling this option may take away samples from more important light sources if it is not needed.

Glass and Transparent Shadows

With caustics disabled glass will miss shadows, and with filter glossy they might be too soft. We can make a glass shader that will **use a Glass BSDF when viewed directly, and a Transparent BSDF when viewed indirectly**. The Transparent BSDF can be used for transparent shadows to find light sources straight through surfaces, and will give properly color shadow, but without the caustics. The Light Path node is used to determine when to use which of the two shaders.



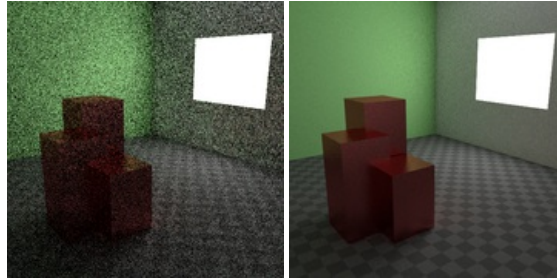
Above we can see the node setup used for the glass transparency trick, with on the left the render with too much shadow due to

missing caustics, and on the right the render with the trick.

Window Lights

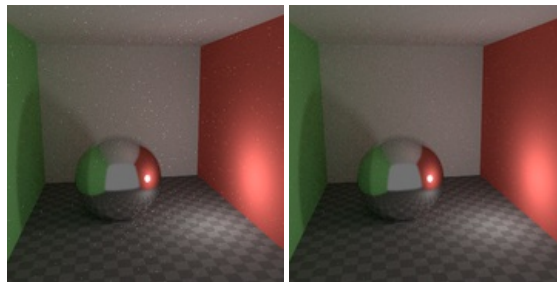
When rendering a daylight indoor scene and most of the light is coming in through a window or door opening, it is difficult for the integrator to find its way to them. We can replace with a plane with an emission shader, placed inside the window opening, so that the integrator knows in which direction to fire rays. For camera rays we can make this mesh light invisible, so that we can still look into the outside scene. This is done either by disabling camera ray visibility on the object, or by switching between glass and emission shaders in the material.

The two renders below have the same render time, with the second render using a mesh light positioned in the window.



Clamp Fireflies

Ideally with all previous tricks fireflies would be eliminated, but they could still happen. For that **the intensity that any individual light ray sample will contribute to a pixel can be clamped** to a maximum value with the integrator [Clamp setting](#). If set too low this can give missing highlights in the image, which might be useful to preserve for camera effects such as bloom or glare.



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Render Passes

Layers

Render layers are used to render different objects in the scene into different images. This way they can be for example color corrected or otherwise manipulated separately and then recomposed in compositing later.

Which objects contribute to which render layers is defined by three layer settings:

- Scene Layers: only objects on these layers will contribute to the image.
- Camera Layers: objects on these layers are directly visible to the camera. When an object is in the scene layers but not camera layers, it will still cast shadows or be visible in reflections, so it's still indirectly visible. This is equivalent to disabling the Camera in the Ray Visibility panel for the object. The way this works may be somewhat confusing at first, but it's designed such that render layers can be recomposed to give the full render, without any missing shadows or reflections.
- Mask Layers: objects on these will mask out other objects appearing behind them. This is equivalent to assigning a Holdout shader for camera rays to the objects on such layers.
- Exclude Layers: scene layers are shared between all render layers, however sometimes it's useful to leave out some object influence for a particular render layer. That's what this option allows you to do.

Lighting Passes

Diffuse Direct

Direct lighting from diffuse BSDFs. We define direct lighting as coming from lamps, emitting surfaces, the background or ambient occlusion after a single reflection or transmission off a surface. BSDF color is not included in this pass.

Diffuse Indirect

Indirect lighting from diffuse BSDFs. We define indirect lighting as coming from lamps, emitting surfaces or the background after more than one reflection or transmission off a surface. BSDF color is not included in this pass.

Diffuse Color

Color weights of diffuse BSDFs. These weights are the color input sock for BSDF nodes, modified by any Mix and Add Shader nodes.

Glossy Direct, Indirect, Color

Same as above, but for glossy BSDFs.

Transmission Direct, Indirect, Color

Same as above, but for transmission BSDFs.

Emission

Emission from directly visible surfaces.

Environment

Emission from the directly visible background. When the film is set to transparent, this can be used to get the environment color and composite it back in.

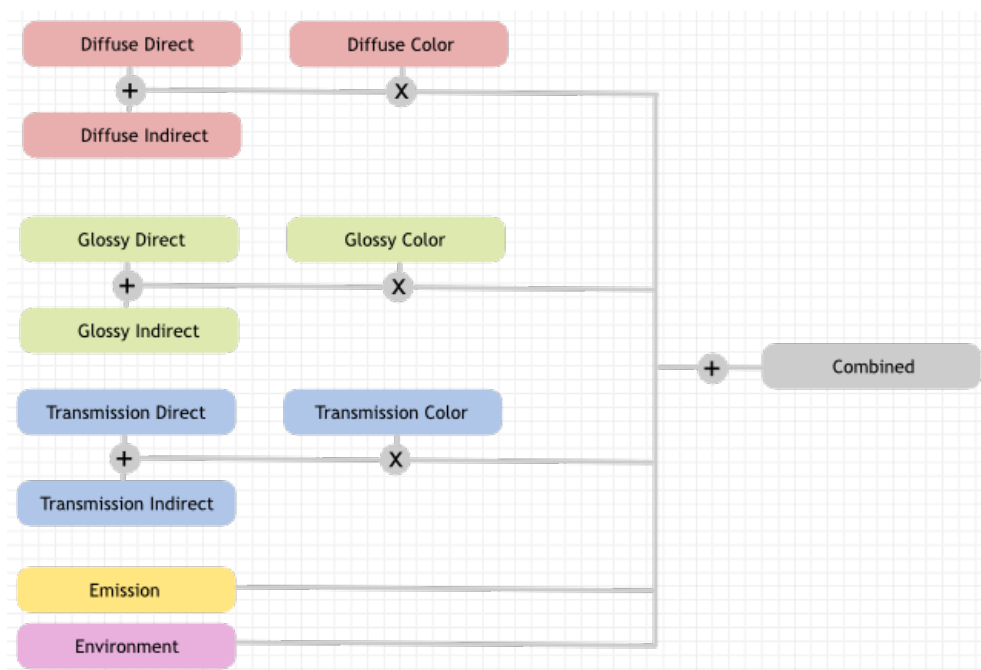
Ambient Occlusion

Ambient occlusion from directly visible surfaces. BSDF color or AO factor is not included, i.e. it gives a 'normalized' value between 0 and 1.

Note that [transparent BSDFs are given special treatment](#), a fully transparent surface is treated as if there is no surface there at all, a partially transparent surface is treated as if only part of the light rays can pass through. This means it is not included in the Transmission passes, for that a glass BSDF with index of refraction 1.0 can be used.

Combining

All these lighting passes can be combined to produce the final image as follows:



Data Passes

Z

Z depth.

Normal

Surface normal used for shading.

UV

Default render UV coordinates.

Object Index

Pass index of object.

Material Index

Pass index of material.

Vector

Motion vectors for the vector blur node. The four components consist of 2D vectors giving the motion towards the next and previous frame position in pixel space.

The Z, Object Index and Material Index passes are not antialiased. This is done because such values can't really be blended correctly.

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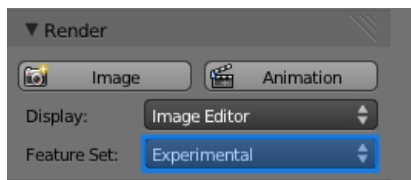
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Experimental Features

Some features in Cycles are not finished yet, but already included in builds for testing. These features may not work, crash Blender or change behavior in later versions.

They are hidden by default, but can be enabled by setting Feature Set to Experimental in the Render properties.



Currently considered experimental:

- OpenCL device
- Displacement
- Subdivision
- CUDA device with compute model < 1.3

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GPU Rendering

Introduction

GPU rendering makes it possible to use your graphics card for rendering, instead of the CPU. This can speed up rendering, because modern GPU's are quite designed to do a lot of number crunching. On the other hand, they also have some limitations for rendering complex scenes, due to more limited memory, and interactivity issue when using the same graphics card for display and rendering.

Cycles has two GPU rendering modes, through CUDA, which is the preferred method for NVidia graphics cards, and OpenCL, which is intended to support rendering on AMD/ATI graphics cards. The implementation of this is only in an experimental stage however, and rendering of an ambient occlusion like image is supported currently.

Configuration

To enable GPU rendering, go into the User Preferences, and under System tab, select the Compute Device(s) to use. Next, for each scene you can configure to use CPU or GPU rendering in the Render properties.

CUDA

NVidia CUDA is supported for GPU rendering with **NVidia graphics cards**. We support graphics cards starting from GTX 2xx (shader model 1.3), however *it is recommended to use a GTX 4xx or GTX 5xx card* (shader model 2.x), since only those are likely to give good speedup, earlier cards are often slower than just using the CPU. Shader model 1.3 cards also do not support some Cycles features, see below.

Cycles requires recent drivers to be installed, on all operating systems. Be sure to download the Blender version matching your operating system, that is, download 64 bit Blender for 64 bit operating systems.

[List of CUDA cards with shader model](#)

Older Cards

For Mac and Linux, it's possible to compile kernels at runtime, for cards that are not officially supported. GeForce 8xxx, 9xxx cards are not included in official release, but they might work by enabling [experimental features](#).

The [CUDA toolkit version 4.0](#) (64 bit version) or newer must be installed for this. Other versions might work, but are not supported. The first time rendering is done, the kernel must be compiled for your GPU architecture. Since Cycles is quite complex compared to a typical GPU kernel, compilation may take from 40 seconds to a few minutes, and may also up about 2GB of memory, depending on the graphics card model.

Missing Features with Shader Model 1.x

Due to limitations of the hardware, compiling a kernel with all features enabled is not possible for these cards. Currently missing are:

- Transparent Shadows
- Sample as Lamp for World textures
- Ambient Occlusion
- Render Passes
- Motion Blur

OpenCL

Implementation not finished yet, marked as [experimental feature](#).

Rendering using **OpenCL is not yet fully supported**, but it is being worked on so we can support more graphics cards. Currently only simple clay rendering is supported, due to our full kernel not compiling with the AMD OpenCL compiler.

The first time rendering is done, the kernel must be compiled for your GPU architecture. Since Cycles is quite complex compared to a typical GPU kernel, compilation may take from 40 seconds to a few minutes, and may also up about 2GB of memory, depending on the graphics card model.

OpenCL version 1.1 or higher is required.

Frequently Asked Questions

Why is Blender unresponsive during rendering?

While a graphics card is rendering, it can not redraw the user interface, which makes interactive unresponsive. . We attempt to avoid

this problem by giving back control over the GPU as often as possible, but a completely smooth interaction can't be guaranteed, especially on heavy scenes. This is a limitation of graphics card for which no true solution exists, though we might be able to improve this somewhat in the future.

If possible, it is best to install more than one GPU, using one for display and the other(s) for rendering.

Why does a scene that renders on the CPU not render on the GPU?

There maybe be multiple causes, but the most common is that there is not enough memory on your graphics card. We can currently only render scenes that fit in graphics card memory, and this is usually smaller than that of the CPU. Note that for example, 8k, 4k, 2k and 1k image textures take up respectively 256MB, 64MB, 16MB and 4MB of memory.

We do intend to add a system to support scenes bigger than GPU memory, but this will not be added soon.

Can I use multiple GPU's for rendering?

Yes, go to User Preferences > System > Compute Device Panel, and configure it to your desire.

Would multiple GPU's increase available memory?

No, each GPU can only access its own memory.

What renders faster, NVidia or AMD, CUDA or OpenCL?

Currently NVidia with CUDA is rendering faster. There is no fundamental reason why this should be so, we don't use any CUDA specific features, but the compiler appears to be more mature, and can better support big kernels. OpenCL support is still being worked on and has not been optimized as much, because we haven't had the full kernel working yet.

Error Messages

Unsupported GNU version! gcc 4.5 and up are not supported!

On Linux, depending on your GCC version you might get this error.

If so, delete the following line in /usr/local/cuda/include/host_config.h

```
#error -- unsupported GNU version! gcc 4.5 and up are not supported!
```

CUDA Error: Invalid kernel image

If you get this error on Windows 64 bit, be sure to use the 64 bit build of Blender, not the 32 bit version.

CUDA Error: Out of memory

This usually means there is not enough memory to store the scene on the GPU. We can currently only render scenes that fit in graphics card memory, and this is usually smaller than that of the CPU. See above for more details.

The NVIDIA OpenGL driver lost connection with the display driver

... due to exceeding the Windows Time-Out limit and is unable to continue.

If a GPU is used for both display and rendering, Windows has a limit on the time the GPU can do render computations. If you have a particularly heavy scene, Cycles can take up too much GPU time. Reducing Tile Size in the Performance panel may alleviate the issue, but the only real solution is to use separate graphics cards for display and rendering.

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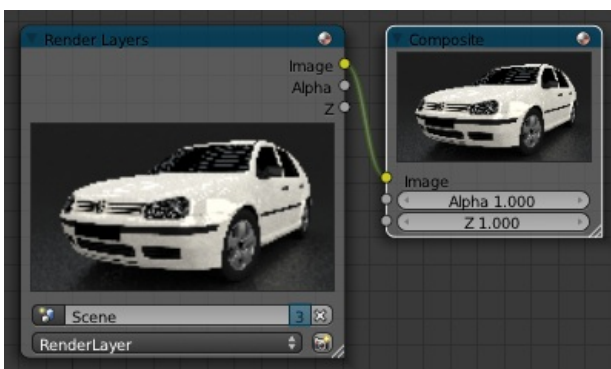
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Composite Nodes

Compositing Nodes allow you assemble and enhance an image (or movie) at the same time. Using composition nodes, you can glue two pieces of footage together and colorize the whole sequence all at once. You can enhance the colors of a single image or an entire movie clip in a static manner or in a dynamic way that changes over time (as the clip progresses). In this way, you use composition nodes to both assemble video clips together, and enhance them.

Term: Image

We use the term *Image* to refer to a single picture, a picture in a numbered sequence of images, or a frame of a movieclip. A node layout will process a sequence one image at a time no matter what kind of input you provide.



To process your image, you will use nodes to import the image into Blender, change it, merge it with other images, and finally save it.

The example to the right shows the simplest noodle; an input node threads the camera view to an output node so it can be saved.

Nodes Concepts

Nodes

"Nodes" are individual blocks that perform a certain operation, and might have one or many different outputs.

Conceptually, there are three basic types of nodes:

- **Input Nodes**

these nodes *produce* information, but do not have any inputs of their own.
Examples are: *Render Layers*, *Value* and *RGB* nodes.

- **Processing Nodes:**

these nodes *filter* or *transform* their inputs, to produce one or more outputs.
Examples are: *RGB Curves*, *Defocus*, and **Vector Blur** nodes.

- **Output Nodes:**

these nodes *consume* their inputs to produce some kind of meaningful result.
Examples are: *Composite* node (which determines the final output used by Blender), *Viewer* (which displays the output of a socket), and **File Output** node.

Noodles

The essential idea of nodes is that you can create an arbitrarily-complex *network* of nodes, by connecting the *outputs* of one or more nodes to the *inputs* of one or more other nodes. Then, you can set appropriate parameters (as you see fit) for each node.

This network is called a "noodle" and it describes how information literally *flows through* to produce whatever result you want.

Node Groups

You can define *node groups*, and use those groups as they were a single node.

You can link and append these node groups from other files.

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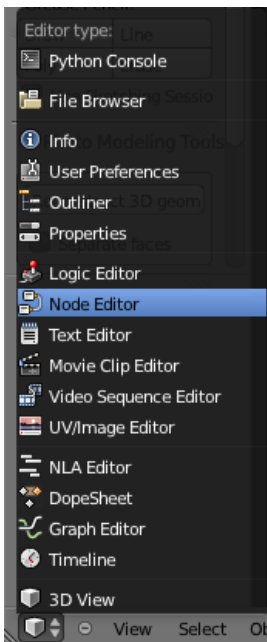
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The Node Editor

This section explains the window in general, and its header menu options. It also tells you how to enable nodes for use within Blender.

Accessing The Node Editor



Select the Node Editor window.

First let's enter the node editor by changing our window type to Node Editor. As shown in *Select the Node Editor window*, click on the window type icon and select Node Editor from the popup list. Node maps can get quite large, so use or create a big window. The window has a graph-paper style background and a header.

Each scene within your blend file can have multiple Material Node map and ONE Compositing Node map. The Node Editor window shows either map, depending on the selector position.

Hint

You might want to add a new window layout called 6-Nodes (the list is shown on the User Preferences header at the top of your screen) comprised mostly of one big Node Editor window. My layout has the buttons window at the bottom and a text editor window on the side for me to keep notes. If you have a widescreen display (or even a regular one), you might also want to add a 3D view or UV/Image Editor window to the left side of the Node window layout, so you can work with images or your model while you're manipulating nodes. Having the 3D Preview Render panel open on top of an object is quite useful if you're tweaking material nodes.

By default, the header, when first displayed, is uninitialized as shown:



Default Node Editor header.

Activating Nodes

- What nodes to use?
 - If you want to work with a material node map, click the ball in the Material/Compositing node set selector. (see *Node Editor Header with Material Nodes enabled.*)
 - If you want to work with a compositing node map, click the face on the Material/Compositing node set selector. (see *Node Editor Header with Compositing Nodes enabled.*)
- To actually activate nodes, click the Use Nodes button.
- The first time that you select either a Material or a Compsiting node map, the Node Editor window will be instantly filled with starter input and output compositing nodes already connected together.



Node Editor Header with Material Nodes enabled.



Node Editor Header with Compositing Nodes enabled.

Node Editor Window Actions

When the cursor is in the window, several standard Blender hotkeys and mouse actions are available, including:

Popup menu

Space - Brings up a main popup menu, allowing you to add, view, select, etc.

Delete

X or Del - Deletes the selected node(s).

Box select

B - Starts the bounding box selection process. Position your cursor and LMB click & drag to select a set of nodes.

Cut connections (box)

LMB click & drag - Starts a box selection, BUT when you let up the mouse button, all threads (connections) within the box are broken.

Undo

CtrlZ Very helpful if you forgot to press B before box-selecting, eh?

Redo

CtrlY or Ctrl⇧ ShiftZ - You can use this if you used "undo" a bit to often :)

Select multiple

⇧ Shift LMB or ⇧ Shift RMB - Multiple node select.

Grab/Move

G - Moves your current selection around.

Execute

E - pumps inputs through the noodle, refreshing everything.

Standard Window Control

Node maps can get pretty hairy (large and complicated, that is). The contents of the window, (the node map) can be panned just like any other Blender window by clicking MMB and dragging about. Wheeling Wheel up/down or using the keypad + NumPad/- NumPad will zoom in/out. The window can be resized and combined using the standard window techniques (see *Navigating in 3d Space*).

Node Editor Header

At a glance

On the window header, you will see header options:

- View - to see things more clearly;
- Select - to do things more clearly;
- Add - to walk with...err..to add Nodes, organized by type;
- Node - to do things with selected nodes, akin to vertices;

- a Material or Compositing node set selector;
- a Use Nodes button;
- a Free Unused button.



Node Editor Header with Material Nodes enabled.



Node Editor Header with Compositing Nodes enabled.

Menus

View, Select and Add

These popup menus provide the basic functions:

View

This menu changes your view of the window, standing in for the standard keyboard shortcuts + NumPad (zoom in), - NumPad (zoom out), ⌘ Home (zoom all) or equivalent mouse actions.

Select

This menu allows you to select a node or groups of nodes, and does the same as typing the hotkey to select all A or start the border select B process.

Add

This menu allows you to add nodes. Please see the next section for a discussion on the types of nodes that you can add, and what they do. Clicking this menu item is the same as pressing Space when the cursor is in the window

Node

Show Cyclic Dependencies

C - Ok, so you've been adding and connecting nodes to your heart's content, and you haven't run out of memory yet. Selecting Show Cyclic Dependencies will show you where you have connected your threads in a circle. For example, you can easily connect a mix output as input to another node, and then connect that node's output back to the mix node input, resulting in a little circle where the image just runs round and round. Left alone, it will eventually get tired and dizzy and crash your computer.

Hide

H - Hides your selected nodes. Just like vertices in a mesh.

Grouping

Most importantly, this menu option allows you to create a user-defined group of nodes. This group can then be edited and added to the map. To create a group, select the nodes you want, and then Node → Make Group, or just use the keyboard shortcut CtrlG. Edit the name using the little input box in the group. Groups are easily identified by their green header and cool names you have picked for them.

Delete

X - Deletes selected nodes.

Duplicate

⇧ ShiftD - Makes an Unlinked copy, with the same settings as the original.

Grab

G - Moves the little nodes around according to your mouse, just like with meshes.

Duplicate - Faked you out

The new copy is placed **exactly over the old one**. But it isn't the connected one, so playing with the controls will do nothing to your images, even though it **looks** like it's connected with the little threads coming out of the node that is **underneath**. You have to move the duplicated node to reveal the connected node beneath it.

Grab - Reminder Only

Just like my mother-in-law, the menu item does not actually do anything; it's just there to remind you that you can press the G key when your cursor is in the window and actually accomplish something with your life (like rearranging nodes in the window).

Buttons

Material/Composite Selector

Nodes are grouped into two categories, based on what they operate on:

- to work with [Material Nodes](#), click on the ball,
- to work with [Compositing nodes](#), click on the face.

Use Nodes Button

This button tells the render engine to use the node map in computing the material color or rendering the final image, or not. If not, the map is ignored and the basic render of the material tabs or scene is accomplished.

Free Unused Button

This button frees up memory space when you have a very complex node map. Recommended.

Backdrop

Use the active viewer node output as a backdrop. When enabled, additional settings appear in the Header and the Properties Panel:


Backdrop Channels

Set the image to be displayed with Color, Color and Alpha, or just Alpha.

Zoom

Sets how big the backdrop image is.

Offset

Change the screen space position of the backdrop, or click the Move button, or shortcut Alt MMB  to manually move it.

Auto Render

Re-render and composite changed layer when edits to the 3d scene are made.

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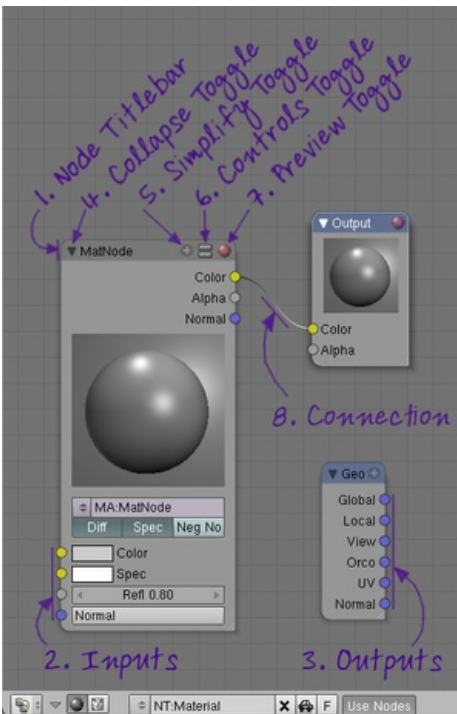
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Node Controls

This page explains the widget to control a node.



Nodes main controls

Titlebar

This contains the node's name, along with several different collapse buttons.

Input sockets

The left side of a node has input sockets:

- *blue sockets* accept vectors
- *yellow sockets* accept colors
- *grey sockets* accept single values (like alpha)

Output sockets

The right side of a node has output sockets:

- *blue sockets* produce vectors
- *yellow sockets* produce colors
- *grey sockets* produce single values (like alpha)

Image preview / Curve

Inside the node there's an area to show the image preview being output by the node or the curves that control the node behaviour (for example in a RGB node).

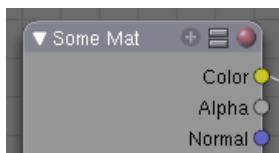
Buttons and menus

Below the image preview there are buttons and menus to control the node behaviour.

Threads

A curved line shows a connection from an output socket to an input socket. The socket types must match. Connections associated with the active node are highlighted for better visibility.

Collapsing toggles



Top of a Node.

At the top of a node there are up to 4 visual controls for the node (*Top of a Node*). Clicking these controls influences how much information the node shows.

Node toggle (▼►)

The arrow on the left collapses/uncollapses the node.

Sockets toggle (+)

The plus-sign button on the right side of the titlebar hides/unhides unused input/output sockets

Menu toggle (≡)

The double-line button in the middle right hides/unhides all of the interface controls.

Preview image toggle (Sphere)

The sphere button on the far right of the titlebar hides/unhides preview image. If the Sphere is **red** this can have 3 reasons:

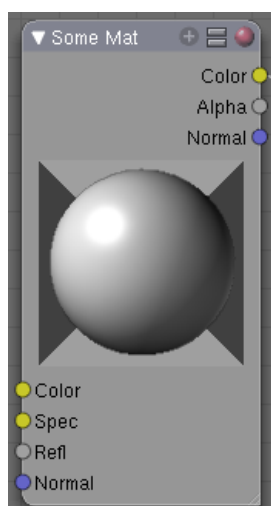
- it's the only effective output node in the node editor.
- it's a [Material input node](#) that has a Material (MA:) assigned to it.



Collapsing Arrow.



Plus Sign.



Menu Collapse.

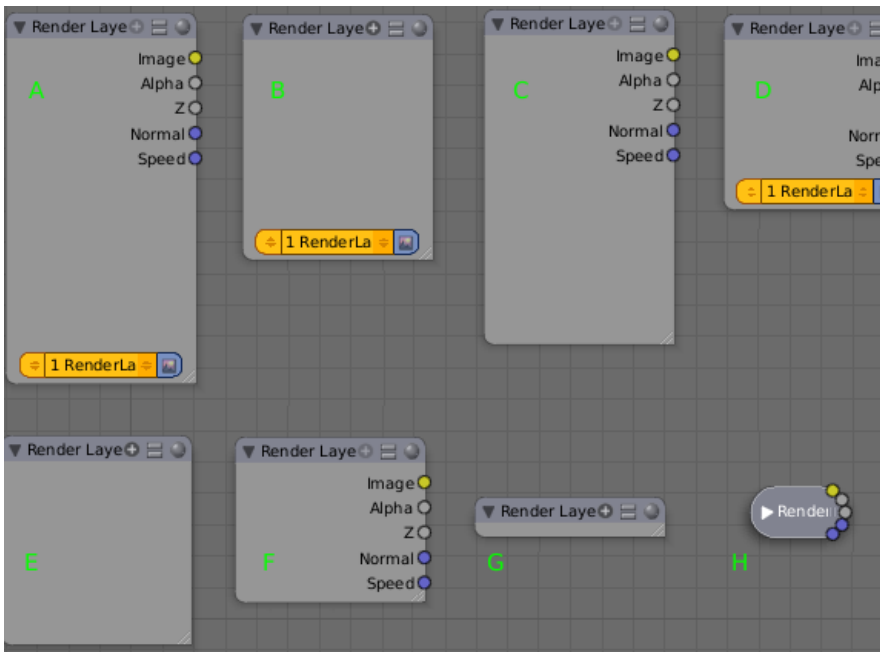


Sphere.



In Combination.


The later three can be used in varying combinations with each other. The arrow that collapses the entire node can only be used in combination with the plus sign (*In Combination*).



Top sizing controls of a Node

A) Normal, B) + Sign clicked, C) = Sign clicked, D) Sphere clicked, E) + and = clicked, F) = and Sphere clicked, G) All three clicked H) Arrow clicked.

Sizing the node

Fine Sizing of an individual node can also be accomplished somewhat by clicking LMB  and dragging in the lower right-hand corner (where the little slanted lines are).

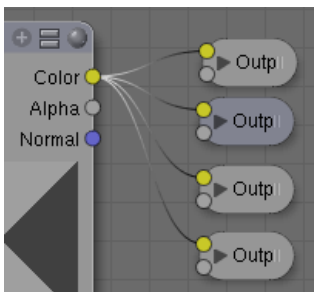
Sockets



Node Sockets.

Each Node in your node window will have "sockets" (often also referred to as "connectors") which are small colored circles to which input data and output data will be linked (*Node Sockets*).

The sockets on the left side of a node describe *inputs*, while the sockets on the right side are *outputs*.



Node Linking.

For your convenience, nodes are *color-coded* according to the type of information they expect to send or receive. There are three colors:

 Yellow sockets

Indicates that **color** information needs to be input or will be output from the node.

 Grey sockets

Indicates values (**numeric**) information. It can either be a single numerical value or a so-called "value map." (You can think of a value map as a grayscale-map where the different amount of bright/dark reflects the value for each point.) If a single value is

used as an input for a "value map" socket, all points of the map are set to this same value.
Common use: Alpha maps and value-options for a node.

 Blue/Purple sockets
Indicates **vector/coordinate/normal** information.

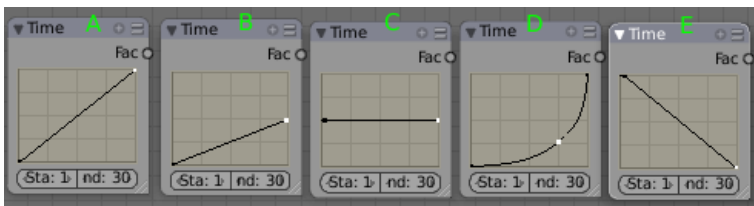
Between nodes, yellow must be linked to yellow, gray to gray, blue to blue, unless you use a *converter*, which we'll cover later on.

Next to the color in the node you will see the name of that socket. Though not always the case, you can see the name of the socket as what the information is *intended* to be. But this is not necessarily what it *has* to be. For example, I can add a link from an gray socket titled Alpha to the material node's gray Reflection socket and still get a result, the key thing being that it's a "gray to gray" connection.


There are exceptions where you can mix yellow (e.g. a color-image) and gray (e.g. grayscale) without converters. Blender normally places a converter if needed, so feel free to experiment with them. You can use the "Viewer" output nodes, as explained in the later sections, to see if/how it works.

Curves

Some nodes have a curve area that translates an input value to an output value. You can modify this curve shape by clicking on a control point and moving it, or adding a control point. Some examples are shown below:



Modifying a curve node.

Every curve starts out as a straight line with a slope of 1. (My daughter NEVER thought she would use her high school algebra. Ha!) The curve starts out with two tiny black control points at each end of the line. Clicking LMB  on a control point selects it and it turns white.

Changing the curve affects how the output is generated. The input, X, usually proceeds linearly (at regular intervals) across the **bottom** axis. Go up until you hit the curve, and then over to the **right** to determine the Y output for that corresponding X. So, for the second example, as X goes from 0 to 1.0 across the bottom, Y varies from 0.0 to 0.5. In the third, as X goes from 0.0 to 1.0 across the bottom, Y stays constant at 0.5. So, in the picture above, these curves have the following affect on time: **A** don't affect, **B** slow down, **C** stop, **D** accelerate, and **E** reverse time.

The "Curves" widget is a built-in feature in Blender's UI, and can be used anywhere, provided the curve data itself is being delivered to this widget. Currently it is in use in the Node Editor and in the UV Window.



This widget will map an input value horizontally and return the new value as indicated by the height of the curve.

Note: The fact that one of the points on the curve is "white" in each of these screen-shots is *not* significant: it just means that it happened to be the point most-recently selected by your author when preparing this tutorial. What matters here is the shape of *the* curve, not the position (nor the color) of the control-points that were used to define it.





RGB Curves

Multiple curves can be edited in a single widget. The typical use, RGB curves, has "Combined" result or "Color" ("C") as the first curve, and provides curves for the individual R, G, and B components. All four curves are active together, the "C" curve gets evaluated first.

Selecting curve points


- LMB  always selects 1 point and deselects the rest.
- Hold  Shift while clicking to extend the selection or select fewer points.

Editing curves

- LMB  click&drag on a point will move points.
- A LMB  click on a curve will add a new point.
- Dragging a point exactly on top of another will merge them.
- Holding  Shift while dragging snaps to grid units.
- Ctrl LMB  adds a point.
- Use the X icon to remove selected points.

Editing the view

The default view is locked to a 0.0-1.0 area. If clipping is set, which is default, you cannot zoom out or drag the view. Disable clipping with the icon resembling a #.

- LMB  click&drag outside of curve moves the view
- Use the + and - icons to zoom in or out.

Special tools

The wrench icon gives a menu with choices to reset a view, to define interpolation of points, or to reset the curve.

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Using nodes

Adding Nodes


Nodes are added in two ways to the node editor window:


- By clicking the Add menu in the node editor toolbar and picking the type of node you want, or
- By having your cursor in the node editor window and pressing Space and picking a node from the popup Add menu.

Arranging Nodes

In general, try to arrange your nodes within the window such that the image flows from left to right, top to bottom. Move a node by clicking on a benign area and dragging it around. The node can be clicked almost anywhere and dragged about; connections will reshape as a bezier curve as best as possible.



Connecting nodes

LMB -click and drag a socket: you will see a branch coming out of it: this is called a "thread".

Kepp dragging and connect the thread to an input socket of another node, then release the LMB .

In this case, a copy of each output is routed along a thread. However, only a single thread can be linked to an input socket.

Disconnecting nodes

To break a link between sockets LMB -click in an empty areas near the thread you want to disconnect and drag: you will see a little cutter icon appearing at your mouse pointer. Move it over the thread itself, and release the LMB .

Duplicating a node

Click on the desidered node, press ⇧ ShiftD and move the mouse away to see the duplicate of the selected node appeaing under the mouse pointer.

Gotcha!

When you duplicate a node, the new node will be positioned *exactly* on top of the node that was duplicated. If you leave it there (and it's quite easy to do so), you can **not** easily tell that there are *two* nodes there! When in doubt, grab a node and move it slightly to see if something's lurking underneath.

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Node Groups

Both material and composite nodes can be grouped. Grouping nodes can simplify the node network layout in the node editor, making your material or composite 'noodle' (node network) easier to work with. Grouping nodes also creates what are called NodeGroups (inside a .blend file) or NodeTrees (when appending).

Conceptually, "grouping" allows you to specify a *set* of nodes that you can treat as though it were "just one node." You can then re-use it one or more times in this or some different .blend file(s).

As an example: If you have created a material using nodes that you would like to use in another .blend file, you *could* simply append the material from one .blend file to another. However, what if you would like to create a new material, and use a branch from an existing material node network? You could re-create the branch. Or you could append the material to the new .blend file, then cut and paste the branch that you want into the new material. Both of these options work, but are not very efficient when working across different .blend files. What if you have created a "Depth of Field" composite node network and would like to use it in another .blend file? What if you wanted to apply exactly the same series of operations, dozens of times? Here again, you *could* re-create the network, but this is not very efficient. A better method of re-use, for either material node branches or composite node networks, would be to create groups of nodes.

Once a group has been defined, it becomes an opaque object; a reusable software component. You can (if you choose) ignore exactly how it is *defined*, and simply use it (as many times as you like) for whatever it *does*. Groups can be made available through the [Blender's library and standard appending method](#).

Grouping Nodes

Panel: [Node Editor](#)

Menu: ⇧ ShiftA → Groups

To create a node group, in the node editor, select the nodes you want to include, then press CtrlG or Space » node » make group. A node group will have a green title bar. All of the selected nodes will now be minimized and contained within the group node. Default naming for the node groups is *NodeGroup*, *NodeGroup.001* etc. There is a name field in the node group you can click into to change the name of the group. Change the name of the node group to something meaningful. When appending node groups from one .blend file to another, Blender does not make a distinction between material node groups or composite node groups, so I recommend some naming convention that will allow you to easily distinguish between the two types. For example, name your material node branches *Mat_XXX*, and your composite node networks *Cmp_XXX*.



What not to include in your groups (all types of Node editors)

Remember that the essential idea is that a group should be an easily-reusable, self-contained, software component. Material node groups should **not include**:

Source nodes

if you include a source node in your group, you'll end up having the source node appearing *twice*: once inside the group, and once outside the group in the new material node-network.

Examples of source nodes are: the *Material Node* (Material nodes editor) and the *Render Layers Node* (Composite Editor).

Output node

if you include an output node in the group, there won't be an output socket available *from* the group!

Examples of output nodes are: the *Output Node* (Material nodes editor) and the *Viewer Node* (Composite Editor).

Editing Node Groups

With a group node selected, pressing ⇧ Tab expands the node to a window frame, and the individual nodes within it are shown to you. You can move them around, play with their individual controls, re-thread them internally, etc. just like you can if they were a normal part of your editor window. You will not be able to thread them to an outside node directly from them; you have to use the external sockets on the side of the Group node. To add or remove nodes from the group, you need to ungroup them.

Ungrouping Nodes

The AltG command destroys the group and places the individual nodes into your editor workspace. No internal connections are lost, and now you can thread internal nodes to other nodes in your workspace.

Appending Node Groups

Once you have appended a NodeTree to your .blend file, you can make use of it in the node editor by pressing Space → Add → Groups, then select the appended group. The "control panel" of the Group is the individual controls for the grouped nodes. You can change them by working with the Group node like any other node.

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Types of Composite Nodes

This section is organized by type of nodes, which are grouped based on similar functions:

- [Input](#) - Adds something to the node map, such as an image or a value.
- [Output](#) - Displays the result in progress as a small image.
- [Color](#) - Manipulates the colors of an image.
- [Vector](#) - Manipulate the intensities and reflections of an image
- [Filters](#) - Process the image to enhance it, working on adjacent pixels.
- [Convertors](#) - Separate the image into its component video, or convert formats.
- [Mattes](#) - Generating mattes to mask off areas of an image.
- [Distortion](#) - Changing the shape of the image.
- [Groups](#) - User-defined groups of nodes.

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Composite Input Nodes

Input nodes *produce* information from some source.

For instance, an input could be:

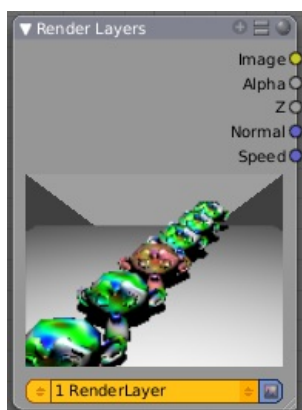
- taken directly from the active camera in a selected scene,
- from a JPG, PNG, etc. file as a static picture,
- a movie clip (such as an animation sequence or home movie), or
- just a color.

These nodes generate the information that feeds other nodes. As such, they have no input-connectors; only outputs.

Render Layers Node

Panel: [Node Editor](#) → [Node Composition](#)

Menu: ⇧ ShiftA → [Input](#) → Render Layers



Render Layers Node

This node is the starting place to getting a picture of your scene into the compositing node map.

This node inputs an image from a scene within your blend file. Select the scene, and the active render layer from the yellow selection list at the bottom of the node. Blender uses the active camera for that scene to create an image of the objects specified in the [RenderLayer](#).

The Image is input into the map, along with the following data:

- Alpha (transparency) mask

Depending on the Renderlayer passes that are enabled, other sockets are available. By default the Z is enabled:

- Z depth map (how far away each pixel is from the camera)

The example shows that two other passes are enabled:

- Normal vector set (how light bounces off the surface)
- Speed vector set (how fast an object is moving from one frame to the next)

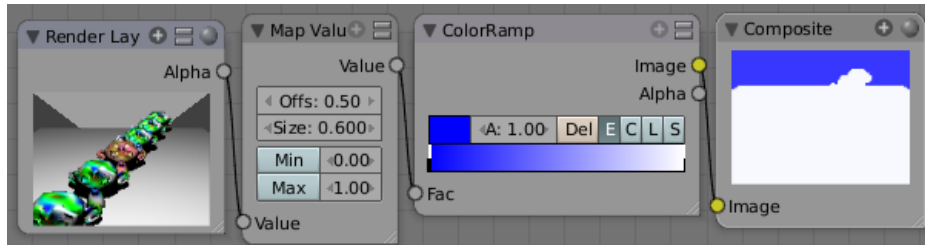
Use the re-render button (Small landscape icon - to the right of the Renderlayer name) to re-render the scene and refresh the image and map.

You may recall that a .blend file may contain many scenes. The Renderlayer node can pick up the scene info from any available scene by selecting the scene from the left-hand selector. If that *other* scene also uses the compositor and/or sequencer, you should note that the scene information taken is the raw information (pre-compositing and pre-sequencing). If you wish to use composited information from another scene, you will have to render that scene to a multilayer OpenEXR frameset as an intermediate file store, and then use the Image input node instead.

Using the Alpha Socket

Using the Alpha output socket is crucial in overlaying images on top of one another and letting a background image "show through" the image in front of it.

In a Blender scene, your objects are floating out there in virtual space. While some objects are in front of one another (Z depth), there is no ultimate background. Your world settings can give you the illusion of a horizon, but it's just that; an illusion. Further, some objects are semi-transparent; this is called having an Alpha value. A semi-transparent object allows light (and any background image) to pass through it to the camera. When you render an image, Blender puts out, in addition to a pretty image, a map of what solid objects actually are there, and where infinity is, and a map of the alpha values for semi-transparent objects. You can see this map by mapping it to a blue screen:



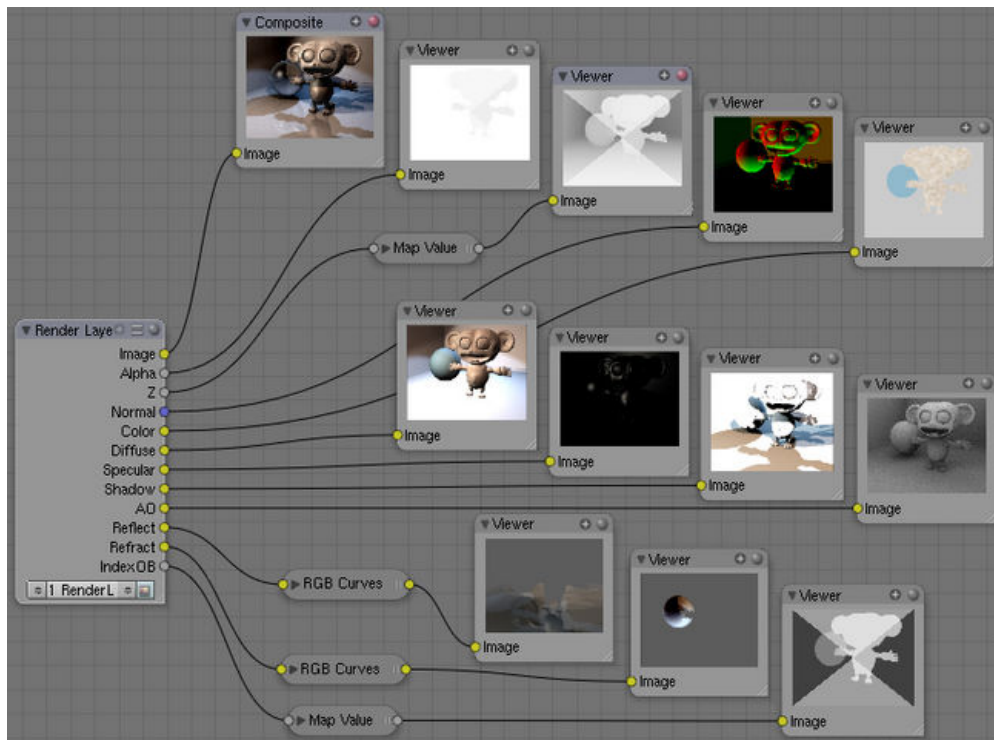
Viewing the Alpha values

In the little node map above, we have connected the Alpha output socket of the RenderLayer node to a Map Value node (explained later, but basically this node takes a set of values and maps them to something we can use). The Color Ramp node (also explained later in detail) takes each value and maps it to a color that we can see with our eyes. Finally, the output of the Color Ramp is output to a Composite viewer to show you, our dear reader, a picture of the Alpha values. Notice that we have set up the map so that things that are perfectly solid (opaque) are white, and things that are perfectly transparent (or where there is nothing) are blue.

Optional Sockets

For any of the optional sockets to appear on the node, you MUST have the corresponding pass enabled. In order for the output socket on the RenderLayer node to show, that pass must be enabled in the RenderLayer panel in the Buttons window. For example, in order to be able to have the Shadow socket show up on the RenderLayer input node, you must have the "Shad" button enabled in the Buttons window, Scene Render buttons, Renderlayer panel. See the RenderLayer tab (Buttons window, Output frame, Render Layers tab, Passes selector buttons) for Blender to put out the values corresponding to the socket.

For a simple scene, a monkey and her bouncy ball, the following picture expertly provides a great example of what each pass looks like:



The available sockets are:

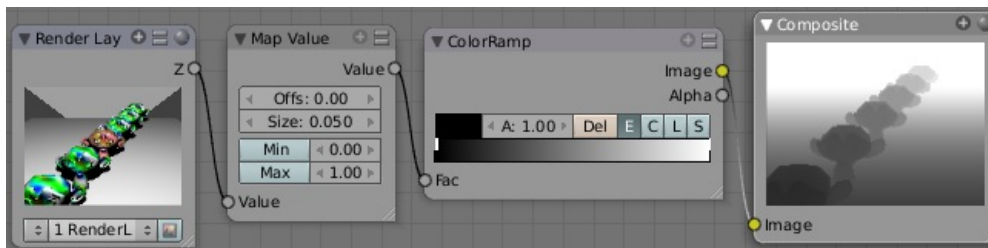
- Z: distance away from the camera, in Blender Units
- Normal (Nor): How the color is affected by light coming from the side
- UV: how the image is distorted by the UV mapping
- Speed (Vec): How fast the object is moving, and in what direction

- Color (Col): the RGB values that color the image that you see.
- Diffuse: the softening of colors as they diffuse through the materials
- Specular: the degree of shininess added to colors as they shine in the light
- Shadow: shadows cast by objects onto other objects
- AO: how the colors are affected by Ambient Occlusion in the world
- Reflect (Ref): for mirror type objects, the colors they reflect and are thus not part of their basic material
- Refract: how colors are bent by passing through transparent objects
- Radio (Radiosity): colors that are emitted by other objects and cast onto the scene
- IndexOB: a numeric ordinal (index) of each object in the scene, as seen by the camera.

Using the Z value Socket

Using the Z output socket is crucial in producing realistic images, since items farther away are blurrier (but more on that later).

Imagine a camera hovering over an X-Y plane. When looking through the camera at the plane, Y is up/down and X is left/right, just like when you are looking at a graph. The camera is up in the air though, so it has a Z value from the X-Y plane, and, from the perspective of the camera, the plane, in fact all the objects that the camera can see, have a Z value as a distance that they are away from it. In addition to the pretty colors of an image, a RenderLayer input node also generates a Z value map. This map is whole bunch of numbers that specify how far away each pixel in the image is away from the camera. You can see this map by translating it into colors, or shades of gray.



Viewing the Z values

In the little node map above, we have connected the Z output socket of the RenderLayer node to a Map Value node (explained later). This node takes a set of values and maps them to something we can use. The Color Ramp node (also explained later in detail) takes each value and maps it to a shade of gray that we can see with our eyes. Finally, the output of the colorramp is output to a Composite viewer to show you, our dear reader, a picture of the Z values. Notice that we have set up the Map Value node so that things closer to the camera appear blacker (think: black is 0, less Z means a smaller number) and pixels/items farther away have an increasing Z distance and therefore get whiter. We chose a Size value of 0.05 to see Z-values ranging from 0 to 20 (20 is 1/0.05).

Using the Speed Socket

Even though things may be animated in our scene, a single image or frame from the animation does not portray any motion; the image from the frame is simply where things are at that particular time. However, from the Render Layers node, Blender puts out a vector set that says how particular pixels are moving, or will move, to the next frame. You use this socket to create a [blurring effect](#). [Find out more by clicking here](#).

Image node

Panel: [Node Editor](#) → [Node Composition](#)

Menu: ⇧ ShiftA → [Input](#) → Image



Image node

The Image node injects any image [format that is supported by Blender](#). Besides inputting the actual image, this node can also input Alpha and depth (Z) values if the image has them. If the image is a MultiLayer format, all saved render passes are input. Use this node to input:

- A single image from a file (such as a JPG picture)
- Part or all of an animation sequence (such as the 30th to 60th frame)
- Part or all of a movie clip (such as an AVI file)

- the image that is currently in the UV/Image Editor (and possibly being painted)
- an image that was loaded in the UV/Image Editor

Animated image sequences or video files can also be used. See [Animations](#) below.

To select an image file or generated image from the UV/Image Editor, click on the small arrow selector button to the left of the name and pick an existing image (e.g. loaded in the UV editor or elsewhere) or click on LOAD NEW to select a file from your hard disk via a file-browser. These images can be e.g. previously rendered images, matte paintings, a picture of your cat, whatever. Blender really doesn't care.

If the image is part of a sequence, manually click the Image Type selector to the right of the name, and select *Sequence*. Additional controls will allow you to define how much of the sequence to pull in (see Animations below). If the file is a video file, these controls will automatically appear.

Image Channels

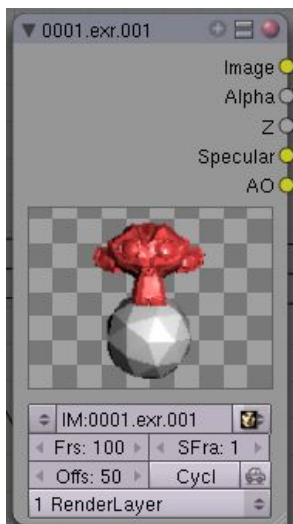
When the image is loaded, the available channels will be shown as sockets on the node. As a minimum, the Image, Alpha, and Z channels are made available. The picture may or may not have an alpha (transparency) and/or Z (depth) channel, depending on the format. If the image format does not support A and/or Z, default values are supplied (1.0 for A, 0.0 for Z).

- Alpha/Transparency Channel
 - If a transparency channel is detected, the Alpha output socket will supply it.
 - If it does not have an Alpha channel (e.g. JPG images), Blender will supply one, setting the whole image to completely opaque. (An Alpha of 1.00, which will show in a Viewer node as white - if connected to the Image input socket).
- Z/depth Channel
 - If a Z (depth) channel is detected, the Z output socket will supply it.
 - If it does not have a Z channel (e.g. JPG or PNG images), Blender will supply one, setting the whole image to be at camera (a depth of 0.00). To view the Z-depth channel, use the Map Value to ColorRamp noodle given above in the Render Layer input node, in the [Render Layer input node](#).

Formats

Blender supports many image formats. Currently only the OpenEXR image format stores RGB (color), A (alpha), and Z (depth) buffer information in a single file, if enabled.

Saving/Retrieving Render Passes



Blender can save the individual Render Layers and specific passes in a MultiLayer file format, which is an extension of the OpenEXR format. In this example, we are reading in frames 50 to 100 of 1 RenderLayer that were generated some time ago. The passes that were saved were the Image, Alpha, Z, Specular and AO pass.

To create a MultiLayer image set, simply disable Do Composite, set your Format to MultiLayer, enable the Render Layer passes you wish to save over the desired frame range, and Animate. Then, in Blender, enable Compositing Nodes and Do Composite, and use the Image input node to read in the EXR file. When you do, you will see each of the saved passes available as sockets for you to use in your compositing noodle.

Image Size

Size matters - Pay attention to image resolution and color depth when mixing and matching images. Aliasing (rough edges), color *flatness*, distorted images, can all be traced to mixing inappropriate resolutions and color depths.

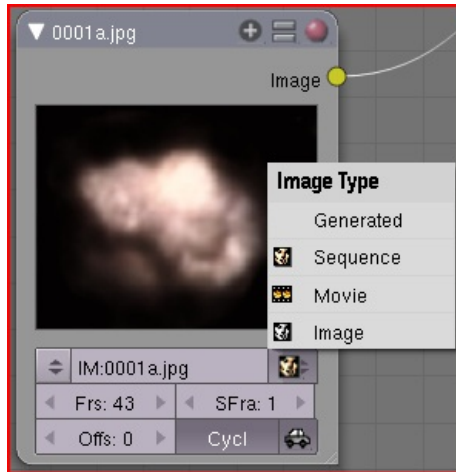
The compositor can mix images with any size, and will only perform operations on pixels where images have an overlap. When nodes

receive inputs with differently sized Images, these rules apply:

- The first/top Image input socket defines the output size.
- The composite is centered by default, unless a translation has been assigned to a buffer with the Translate node.

So each node in a composite can operate on different sized images, as defined by its inputs. Only the Composite output node has a fixed size, as defined by the Scene buttons (Format Panel - F10). The Viewer node always shows the size from its input, but when not linked (or linked to a value) it shows a small 320x256 pixel image.

Animations



To use image sequences or movies within your composition, press the face or little film strip button located to the right of the selector. As you click, a pop-up will offer you four choices:

1. Generated -
2. Sequence - a sequence of frames, each frame in a separate file.
3. Movie - a sequence of frames packed into a single .avi or .mov file
4. Image - a single frame or still image in a file

A Movie or Image can be named anything, but a Sequence must have a digit sequence somewhere in its filename, for example fire0001set.jpg, fire0002set.jpg, fire0003set.jpg and so on. The number indicates the frame.

If a Sequence or Movie is selected, an additional set of controls will appear that allows you to select part or all of the sequence. Use these controls to specify which frames, out of the original sequence, that you want to introduce into the animation you are about to render. You can start at the beginning and only use the beginning, or even pick out a set of frames from the middle of an existing animation.

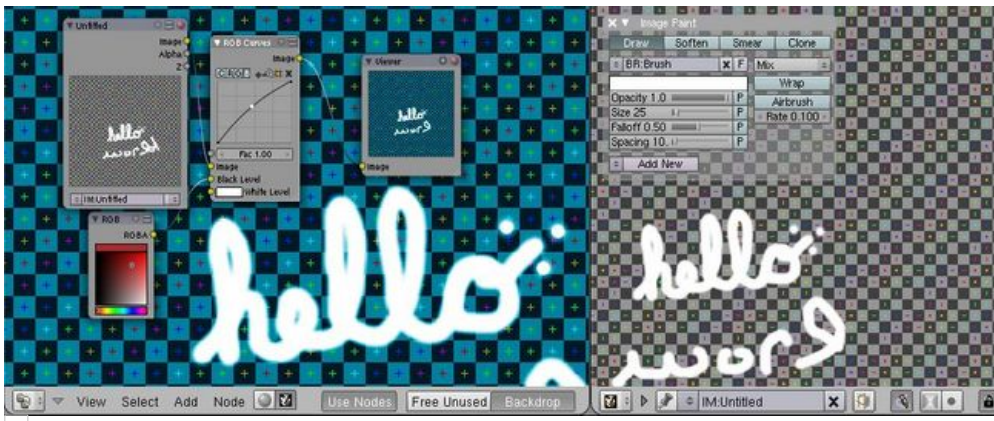
The Frs number button is the number of frames in the sequence that you want to show. For example, if you want to show 2 seconds of the animation, and are running 30 fps, you would put 60 here.

The SFra number button sets the start frame of the animation; namely, at what point in the animation that you *are going to render* do you want this sequence to start playing. For example, if you want to introduce this clip ten seconds into the composite output, you would put 300 here (at 30 fps).

The First number button sets the first number in the animated sequence name. For example, if your images were called "credits-0001.png", "credits-0002.png" through "credits-0300.png" and you wanted to start picking up with frame 20, you'd put 20 here.

To have the movie/sequence start over and repeat when it is done, press the Cyclic button. For example, if you were compositing a fan into a room, and the fan animation lasted 30 frames, the animation would start over at frame 31, 61, 91, and so on, continuously looping. As you scrub from frame to frame, to see the actual video frame used for the current frame of animation, press the auto button to the right of the Cyclic button.

Generated Images



Using the Nodes to modify a painting in progress in the UV/Image window

Blender features [Texture Paint](#) which works in the UV/Image Editor, that allows you to paint on the fly, and the image is kept in memory or saved. If sync lock is enabled (the lock icon in the header), changes are broadcast throughout Blender as soon as you lift the mouse button. One of the places that the image can go is to the Image Input node. The example shows a painting session going on in the right-hand UV/Image Editor window for the painting "Untitled". Create this image via Image->New in the UV/Image Editor. Refer to the texture paint section of the user manual for more info on using Texture Paint.

In the left-hand window, the Image input node was used to select that "Untitled" image. Notice that the Image type icon is blank, indicating that it is pulling in a Generated image. That image is colorized by the noodle, with the result used as a backdrop in the Node Editor Window.

Using this setup and the Generated Image type is like painting and post-processing as you continue painting. Changes to either the painting or the post-pro noodle are dynamic and real-time.

Notes

No Frame Stretching or Compression: If the input animation (avi or frame set) was encoded at a frame rate that is *different* from your current settings, the resultant animation will appear to run faster or slower. Blender Nodes do not adjust input video frame rates. Use the scale control inside the [Video Sequence Editor](#) to stretch or compress video to the desired speed, and input it here. You can incorporate "Slow-Mo" into your video. To do so, ANimate a video segment at 60 frames per second, and input it via this node, using Render settings that have an animation frame rate of the normal 30 fps; the resulting video will be played at half speed. Do the opposite to mimic Flash running around at hyperspeed.

AVI (Audio Video Interlaced) files are encoded and often compressed using a routine called a *Codec*. You must have a codec installed on your machine and available to Blender that understands and is able to read the file, in order for Blender to be able to de-code and extract frames from the file. If you get the error message **FFMPEG or unsupported video format** when trying to load the file, you need to get a Codec that understands the video file. Contact the author of the file and find out how it was encoded. An outside package, such as VirtualDub, might help you track this information down. Codecs are supplied by video device manufacturers, Microsoft, DivX, and Xvid, among others, and can often be downloaded from their web sites for free.

Splicing Video Sequences using Nodes

The above animation controls, coupled with a little mixing, is all you need to splice video sequences together. There are many kinds of splices:

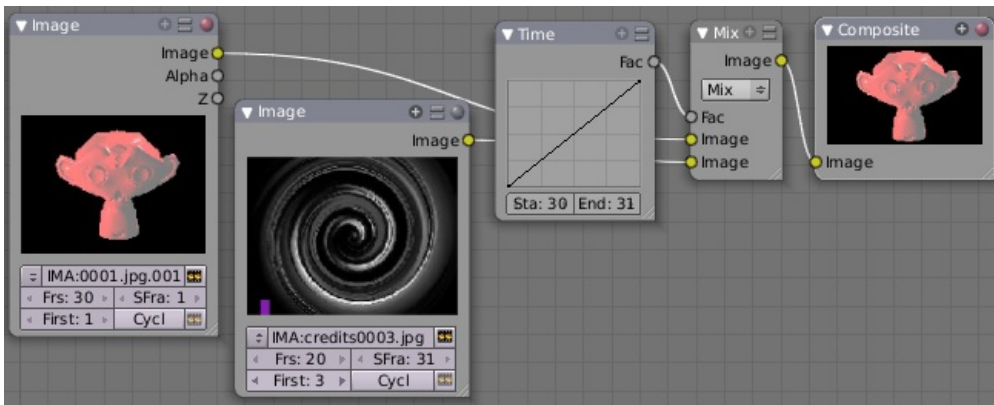
- Cut Splice - literally the ends of the footage are just stuck together
- Fade In - The scene fades in, usually from black
- Fade Out - The scene fades out, usually to black
- Mix - Toward the end of one scene, the images from the next scene meld in as the first scene fades
- Winking and Blinking - fading one cut out while the other fades in, partially or totally through black
- Bumps and Wipes - one cut bumps the other one out of frame, or wipes over it (like from the top left corner down)

Cut Splicing using Nodes

In the example noodle below, we have two pieces of footage that we want to cut splice together.

- Magic Monkey - named 0001.png through 0030.png
- Credits - named credits0001.png through credits0030.png

The editor has reviewed the Credits and thought the first two frames could be thrown away (onto the cutting room floor, as they say) along with the last 8, leaving 20 frames from the total shot. Not shown in this image, but crucial, is that in the Output panel, we set our render output filename to "Monkey-Credits-", and our Animation start and end frames to 1 and 50 (30 from the Monkey, 20 from the credits). Notice the Time node; it tells the Mix node to use the top image until frame 30, and then, at frame 31, changes the Mix factor to 1, which means to use the bottom set of images.



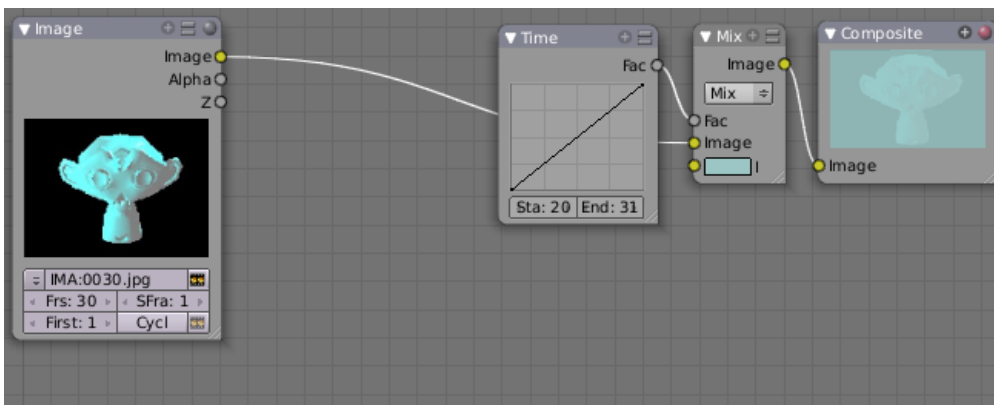
Cut Splice using Nodes

Upon pressing the ANIM button, Blender will composite the animation. If you specified an image format for output, for example, PNG, Blender will create 50 files, named "Monkey-Credits-0001.png" through "Monkey-Credits-0050.png". If you specified a movie format as output, such as AVI-JPEG, then Blender will create only one file, "Monkey-Credits-avi", containing all 50 frames.

Use cut scenes for rapid-fire transition, conveying a sense of energy and excitement, and to pack in a lot of action in a short time. Try to avoid cutting from a dark scene to a light one, because it's hard on the eyes. It is very emotionally contrasting, and sometimes humorous and ironic, to cut from a very active actor in one scene to a very still actor in another scene, a la old Road Runner and Coyote scenes.

Fade Splicing using Nodes

In the previous topic, we saw how to cut from one sequence to another. To fade in or out, we simply replace one set of images with a flat color, and expand the Time frame for the splice. In the image below, beginning at frame 20, we start fading **out** to cyan:



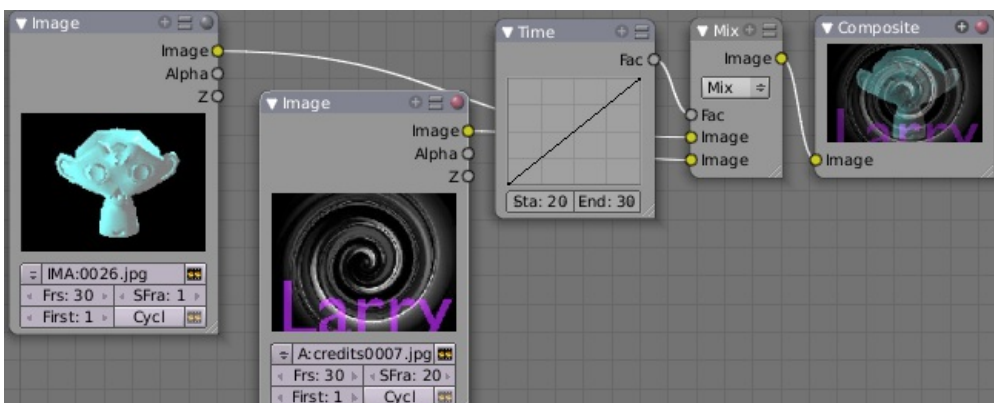
Fading Out using Nodes

Cyan was chosen because that is the color of the Monkey at that time, but you can just as easily choose any color. The image below shows frame 30, when we have almost faded completely.

To fade **in**, change the Mix node and plug the image sequence into the bottom socket, and specify a flat color for the top socket.

Mix Splice using Nodes

To mix, or crossover, from one scene to the next, start feeding the second scene in while the first is mixing out. The noodle below shows frame 25 of a mix crossover special effect to transition from one scene to the next, beginning at frame 20 with the transition completed by frame 30. Action continues in the first scene as it fades out and is mixed with action that starts in the second scene.

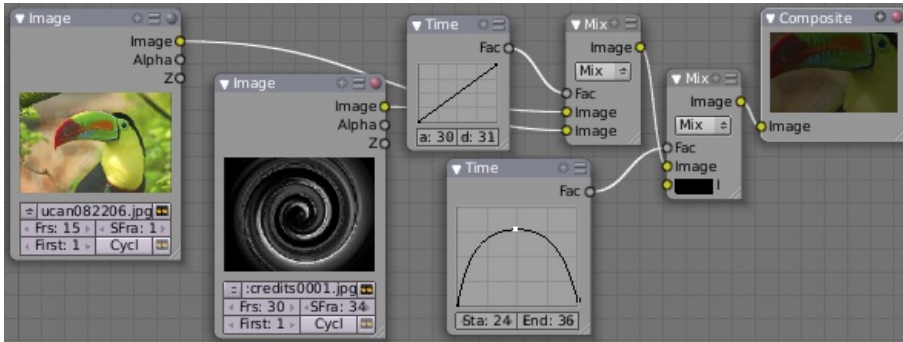


Mix Splice using Nodes

Use this effect to convey similarities between the two scenes. For example, Scene 1 is the robber walking down the street, ending with the camera focusing in on his feet. Scene 2 is a cop walking down the street after him, starting with his feet and working its way up to reveal that the cop is following the robber.

Wink Splice using Nodes

A Wink is just like blinking your eyes; one scene fades to black and the other fades in. To use Blender to get this effect, build on the Cut and Fade splices discussed above to yield:



A Wink using Nodes

In the above example, showing frame 27, we have adjusted some parameters to show you the power of Blender and how to use its Nodes to achieve just the blended crossover effect you desire:

- Postfeed: Even though there were only 15 frames of animation in the Toucan strip, the cutover (top Time node) does not occur until frame 30. Blender continues to put out the last frame of an animation, *automatically extending it for you*, for frames out of the strip's range.
- Prefeed: Even though the swirl does not start playing until frame 34, Blender supplies the first frame of it for Frames 31 through 33. In fact, it supplies this image all the way back to frame 1.
- Partial Fade: Notice the second 'wink' Time node. Like a real wink, it does not totally fade to black; only about 75%. When transitioning between scenes where you want some visual carryover, use this effect because there is not a break in perceptual sequence.

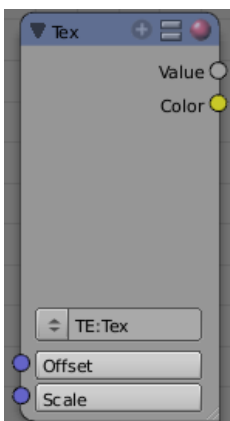
Multiple Feeds

The above examples call out two feeds, but by replicating the Input, Time and Mix nodes, you can have multiple feeds at any one time; just set the Time node to tell the Mixer when to cut over to using it.

Texture Node

Panel: [Node Editor](#) → [Node Composition](#)

Menu: ⇧ ShiftA → [Input](#) → Texture



Texture node

The Texture node makes 3D textures available to the compositor.

The Texture node makes 3D textures available to the compositor. A texture, from the list of textures available in the current blend file, is selected and introduced through the value and/or color socket.

Note

Please read up on the Blender Library system for help on importing and linking to textures in other blender files.

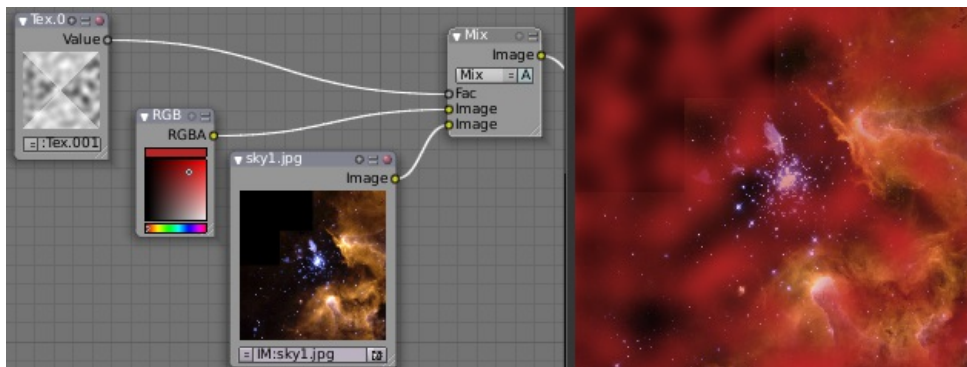
Note

You cannot edit the textures themselves in the node window. To use this node, create and edit the texture in the normal texture buttons, then select the texture from the menu button on the node.

You can change the Offset and a Scale (which is called Offs XYZ and Size XYZ in the Materials Texture Map Input panel) for the texture by clicking on the label and setting the sliders, thus affecting how the texture is applied to the image. For animation, note that this is a vector input socket, because the XYZ values are needed.

Texture nodes can output a straight black-and-white Value image (don't mistake this for alpha) and an image (Color).

Example



In the example above, we want to simulate some red plasma gas out there in space. So, we fog up an image taken from the Hubble telescope of Orion and take the ever-so-useful Cloud texture and use it to mix in red with the image.

Value node

Panel: [Node Editor](#) → [Node Composition](#)

Menu: ⇧ ShiftA → [Input](#) → Value

The Value node has no inputs; it just outputs a numerical value (floating point spanning 0.00 to 1.00) currently entered in the NumButton displayed in its controls selection.

Use this node to supply a constant, fixed value to other nodes' value or factor input sockets.

RGB node

Panel: [Node Editor](#) → [Node Composition](#)

Menu: ⇧ ShiftA → [Input](#) → RGB

The RGB node has no inputs. It just outputs the Color currently selected in its controls section; a sample of it is shown in the top box. In the example to the right, a gray color with a tinge of red is selected.

To change the brightness and saturation of the color, LMB click anywhere within the square gradient. The current saturation is shown as a little circle within the gradient. To change the color itself, click anywhere along the rainbow Color Ramp.

Example

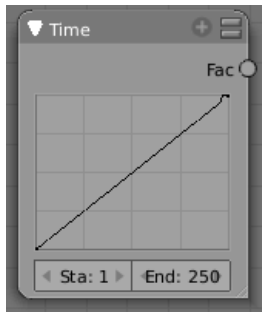


In this example, our corporate color is teal, but the bozo who made the presentation forgot. So, we multiply his lame black and white image with our corporate color to save him from embarrassment in front of the boss when he gives his boring presentation.

Time node

Panel: [Node Editor](#) → [Node Composition](#)

Menu: ⇧ ShiftA → [Input](#) → Time



Time node

The Time node generates a factor value (from 0.00 to 1.00) (that changes according to the curve drawn) as time progresses through your movie (frames).

The Start and End NumButtons specify the range of time the values should be output along, and this range becomes the X-axis of the graph. The curve defines the Y-value and hence the factor that is output. In the example to the right, since the timespan is 250 frames and the line is straight from corner to corner, 0.50 would be output at frame 125, and 0.75 will be output at frame 187.

Note on output values

The [Map Value](#) node can be used to map the output to a more appropriate value. With some time curves, it is possible that the Time node may output a number larger than one or less than zero. To be safe, use the Min/Max clamping function of the Map Value node to limit output.

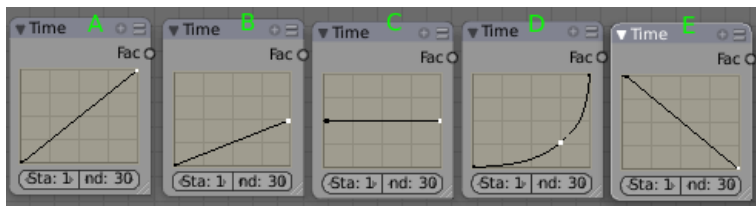
You can reverse time (unfortunately, only in Blender and not in the real world) by specifying a Start frame greater than the End frame. The net effect of doing so is to flip the curve around. Warning: doing so is easily overlooked in your node map and can be very confusing (like meeting your mother when she was/is your age in "Back to the Future").

Time is Relative

In Blender, time is measured in frames. The actual duration of a time span depends on how fast those frames whiz by (frame rate). You set the frame rate in your animation settings ([Scene Context](#) F10). Common settings range from 5 seconds per frame for slideshows (0.2 fps), to 30 fps for US movies.

Time Node Examples

In the picture below, over the course of a second of time (30 frames), the following time controls are made:



A) No Effect B) Slow Down C) Freeze D) Accelerate E) Reverse

Common uses for this include a ["fade to black"](#), wherein the accelerate time curve (typically exponentially-shaped) feeds a mix value that mixes a constant black color in, so that the blackness accelerates and eventually darkens the image to total black. Other good uses include an increasing soften (blur-out or -in) effect, or [fade-in](#) a background or foreground, instead of just jumping things into or out of the scene.

You can even imagine hooking up one blur to a background renderlayer, another inverted blur to a foreground renderlayer, and time feeding both. This node group would simulate someone focusing the camera lens.

Examples and suggestions

As your imagination runs wild, consider a few ideas that came to me just now on my couch: mixing a clouds texture with a time input to fog up a piece of glass or show spray paint building up on a wall. Consider mixing red and the soften with time (decreasing output) to show what someone sees when waking up from a hard hit on the head. Mix HSV input with a starfield image with time (decreasing output) to show what we might see someday as we accelerate our starship and experience red-shift.

As a user, you should know that we have arrived at the point where there are many ways to do the same thing in Blender. For example, an old way to make a slide show using Blender, you created multiple image textures, one image for each slide, and assigned them as texture channels to the material for the screen, then created a screen (plane) that filled the camera view. Using a material ipo, you would adjust the Color influence of each channel at different frames, fading one in as the previous slide faded out. Whew! Rearranging

slide and changing the timing was clunky but doable by moving the IPO keys. The *Node* way is to create an image input, one for each slide image. Using the Image input and Time nodes connected to an AlphaOver mixer is much simpler, clearer, and easier to maintain.

Page status ([reviewing guidelines](#))

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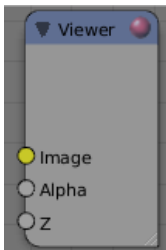
Proposed fixes: none

Composite Output Nodes

At any point, you may want to see or save the working image in progress, especially right after some operation by a node. Simply create another thread from the image output socket of the node to an Output node to see a mini-picture.



Only one Viewer and one Composite Node is active, which is indicated with a red sphere icon in the Node header. Clicking on Viewer Nodes makes them active. The active Composite Node is always the first, and you should only use one anyway.

Viewer



Viewer node


The Viewer node is a temporary, in-process viewer. Plug it in wherever you would like to see an image or value-map in your node-tree.

LMB  click on the image to update it, if it wasn't done automatically. You can use as many of these as you would like. It is possible to automatically plug a Viewer node to any other node by pressing ⇧ Shift LMB  on it.

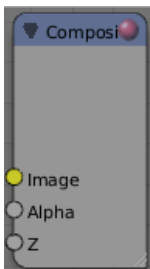
Using the UV/Image Editor Window

The Viewer node allows results to be displayed in the UV/Image Editor. The image is facilitated by selecting the IM:Viewer Node on the window's header. The UV/Image Editor will display the image from the currently selected viewer node.

To save the image being viewed, use the Image->Save As menu to save the image in a file.

The UV/Image Editor also has three additional options in its header to view Images with or without Alpha, or to view the Alpha or Z itself. Holding LMB  in the Image display allows you to sample the values.

Composite



Composite node

The Composite node is where the actual output from the compositor is connected to the renderer. Connecting a node to the Composite node will output the result of that node's full tree to the Renderer, leaving this node unconnected will result in a blank image. This node is updated after each render, but also if you change things in your node-tree (provided at least one finished input node is connected).

You can connect three channels: the actual RGBA image, the Alpha image, and the Z (depth) image. You should only have one Composite node in your map so that only one final image is rendered when the Compositing button is pressed on the Render Options Post-Processing panel. Otherwise, unpredictable results may occur.

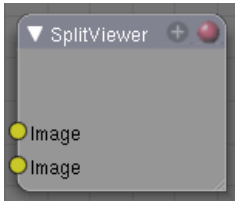
Saving your Composite Image

The RENDER button renders a single frame or image. Save your image using F3 or the File->Save Image menu. The image will be saved using the image format settings on the Render panel.

To save a sequence of images, for example if you input a movie clip or used a Time node, with each frame in its own file, use the ANIM button and its settings. If you might want to later overlay them, be sure to use an image format that supports an Alpha channel (such as PNG). If you might want to later arrange them front to back or create a depth of field effect, use a format that supports a Z-depth channel (such as EXR).

To save a composition as a movie clip (all frames in a single file), use an AVI or Quicktime format, and use the ANIM button and its settings.

SplitViewer Node



SplitViewer node

The SplitViewer node takes two images and displays one half of each on each side (top socket on the right half, bottom socket input on the left). Use this node for making side-by-side comparisons of two renderings/images, perhaps from different renderlayers or from different scenes. When transitioning between scenes, you want to be sure the stop action is seamless; use this node to compare the end of one scene with the beginning of another to ensure they align.

File Output Node



File Output node

This node puts out an RGBA image, in the format selected, for each frame range specified, to the filename entered, as part of a frameset sequence. This means that the name of the file will be the name you enter plus a numeric frame number, plus the filename extension (based on format). Based on the format you choose, various quality/compression options may be shown.

To support subsequent arrangement and layering of images, the node can supply a Z-depth map. However, please note that only the OpenEXR image formats save the Z information.

The image is saved whenever Blender feels like it. Just kidding; whenever you press the Render button, the current frame image is saved. When you press the Anim button, the frameset sequence (specified in the Start and End frame) is saved.

This node saves you from doing (or forgetting to do) the Save Image after a render; the image is saved automatically for you. In addition, since this node can be hooked in anywhere in the noodle, you can save intermediate images automatically. Neat, huh?

Filespecs

As with all filename entries, use // at the beginning of the field to shorthand reference the current directory of the .blend file. You can also use the .. breadcrumb to go up a directory.

Levels Node

The Levels Node takes an image as an input, and can output a 1D value based on the levels of an image. It can read the input's Combined RGB, {{Literal|Red}}, Green, Blue, or Luminance channels.

It can output a Mean value, or average of values, or a Standard deviation, which measures the diversity of values.

Page status ([reviewing guidelines](#))

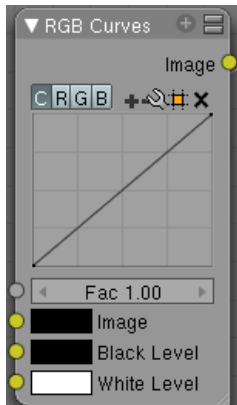
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Proposed fixes: none

Composite Color Nodes

These nodes play with the colors in the image. They adjust the image's color intensity, adjust contrast and intensity, and, most importantly, mix two images together by color, transparency, or distance.

RGB Curves Node

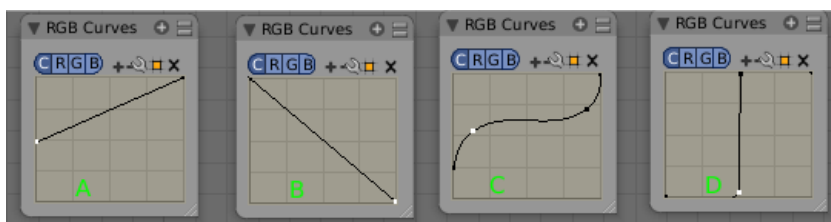


RGB Curves node

For each color component channel (RGB) or the composite (C), this node allows you to define a bezier curve that varies the input (across the bottom, or x-axis) to produce an output value (the y-axis). By default, it is a straight line with a constant slope, so that .5 along the x-axis results in a .5 y-axis output. Click and drag along the curve to create a control point and to change the curve's shape. Use the X to delete the selected (white) point.

Clicking on each C R G B component displays the curve for that channel. For example, making the composite curve flatter (by clicking and dragging the left-hand point of the curve up) means that a little amount of color will result in a lot more color (a higher Y value). Effectively, this bolsters the faint details while reducing overall contrast. You can also set a curve just for the red, and for example, set the curve so that a little red does not show at all, but a lot of red does.

Here are some common curves you can use to achieve desired effects:



A) Lighten B) Negative C) Decrease Contrast D) Posterize

Options

Fac

How much the node should factor in its settings and affect the output

Black Level

Defines the input color that is mapped to black. Default is black, which does not change the image.

White Level

Defines the input color that is mapped to white. Default is white, which does not change the image.

The levels work exactly like the ones in the image viewer. Input colors are scaled linearly to match black/white levels.

To define the levels, either use LMB on the color patch to bring up the color selection widget or connect some RGBA input to the sockets.

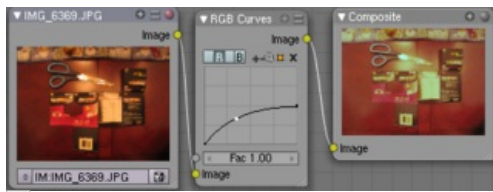
To only affect the value/contrast (not hue) of the output, set the levels to shades of gray. This is equivalent to setting a linear curve for C.

If you set any level to a color with a saturation greater than 0, the output colors will change accordingly, allowing for basic color

correction or effects. This is equivalent to setting linear curves for R, G and B.

Examples

Color correction using Curves



Color correction with curves

In this example, the image has way too much red in it, so we run it through an RGB node and reduce the Red channel by about half.

We added a middle dot so we could make the line into a sideways exponential curve. This kind of curve evens out the amount of a color in an image as it reaches saturation. Also, read on for examples of the Darken and Contrast Enhancement curves.

Color correction using Black/White Levels



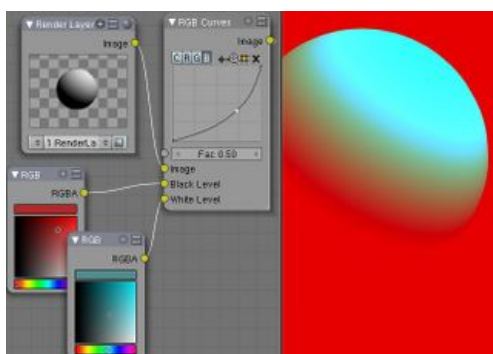
Color correction with Black/White Levels

Manually adjusting the RGB curves for color correction can be difficult. Another option for color correction is to use the Black and White Levels instead, which really might be their main purpose.

In this example, the White Level is set to the color of a bright spot of the sand in the background, and the Black Level to the color in the center of the fish's eye. To do this efficiently it's best to bring up an image viewer window showing the original input image. You can then use the levels' color picker to easily choose the appropriate colors from the input image, zooming in to pixel level if necessary. The result can be fine-tuned with the R,G, and B curves like in the previous example.

The curve for C is used to compensate the increased contrast that is a side-effect of setting Black and White Levels.

Effects



Changing colors

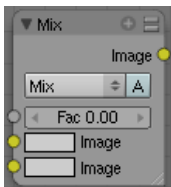
Curves and Black/White Levels can also be used to completely change the colors of an image.

Note that e.g. setting Black Level to red and White Level to blue does not simply substitute black with red and white with blue as the example image might suggest. Levels do color scaling, not substitution, but depending on the settings they can result in the described color substitution.

(What really happens when setting Black Level to pure red and White Level to pure blue is that the red channel gets inverted, green gets reduced to zero and blue remains unchanged.)

Because of this the results of setting arbitrary Black/White Levels or RGB curves is hard to predict, but can be fun to play with.

Mix Node



This node mixes a base image (threaded to the top socket) together with a second image (bottom socket) by working on the individual and corresponding pixels in the two images or surfaces. The way the output image is produced is selected in the drop-down menu. The size (output resolution) of the image produced by the mix node is the size of the base image. The alpha and Z channels are mixed as well.

Not one, not two, but count 'em, *sixteen* mixing choices include:

Mix

The background pixel is covered by the foreground using alpha values.

Add

The pixels are added together. *Fac* controls how much of the second socket to add in. Gives a bright result. The "opposite" to Subtract mode.

Subtract

Pixels are subtracted from one another. Gives a dark result. The "opposite" to Add mode.

Multiply

Returns a darker result than either pixel in most cases (except one of them equals white=1). Completely white layers do not change the background at all. Completely black layers give a black result. The "opposite" to Screen mode.

Screen

Both pixel values are inverted, multiplied by each other, the result is inverted again. This returns a brighter result than both input pixels in most cases (except one of them equals 0). Completely black layers do not change the background at all (and vice versa) - completely white layers give a white result. The "opposite" of Multiply mode.

Overlay

A combination of Screen and Multiply mode, depending on the base color.

Divide

The background pixel (top socket) is divided by the second one: if this one is white (= 1.0), the first one isn't changed; the darker the second one, the brighter is the result (division by 0.5 - median gray - is same as multiplication by 2.0); if the second is black (= 0.0, zero-division is impossible!), Blender doesn't modify the background pixel.

Difference

Both pixels are subtracted from one another, the absolute value is taken. So the result shows the distance between both parameters, black stands for equal colors, white for opposite colors (one is black, the other white). The result looks a bit strange in many cases. This mode can be used to invert parts of the base image, and to compare two images (results in black if they are equal).

Darken

Both pixels are compared to each other, the smaller one is taken. Completely white layers do not change the background at all, and completely black layers give a black result.

Lighten

Both parameters are compared to each other, the larger one is taken. Completely black layers do not change the image at all and white layers give a white result.

Dodge

brightens the one socket by the gradient in the other socket. Results in lighter areas of the image where the gradient is whiter. Use the *Fac* to control how much the gradient affects the other socket.

Burn

Darkens one socket based on the gradient fed to the other socket. Results in darker images, since the image is *burned* onto the paper, er..image (showing my age).

Color

Adds a color to a pixel, tinting the overall whole with the color. Use this to increase the tint of an image.

Value

The RGB values of both pixels are converted to HSV values. The values of both pixels are blended, and the hue and saturation of the base image is combined with the blended value and converted back to RGB.

Saturation

The RGB values of both pixels are converted to HSV values. The saturation of both pixels are blended, and the hue and value of the base image is combined with the blended saturation and converted back to RGB.

Hue

The RGB values of both pixels are converted to HSV values. The hue of both pixels are blended, and the value and saturation of the base image is combined with the blended hue and converted back to RGB.

Color Channels

There are two ways to express the channels that are combined to result in a color: RGB or HSV. RGB stands for the Red,Green,Blue pixel format, and HSV stands for Hue,Saturation,Value pixel format.

Alpha

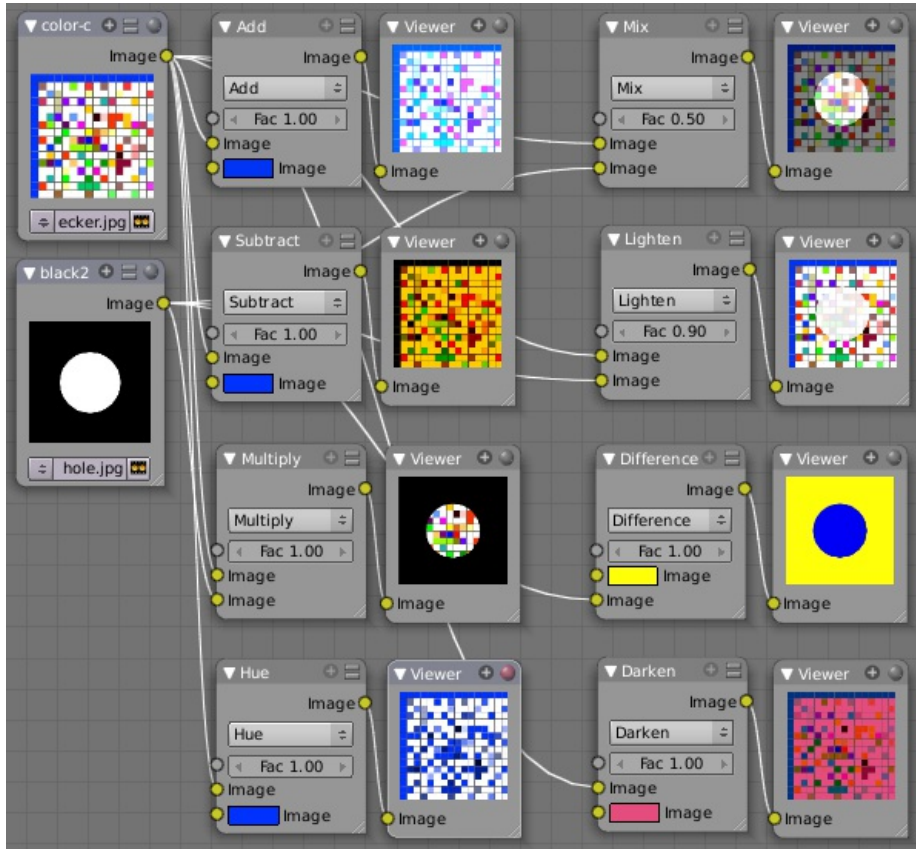
Click the Alpha button to make the mix node use the Alpha (transparency) values of the second (bottom) node. If enabled, the resulting image will have an Alpha channel that reflects both images' channels. Otherwise, (when not enabled, light green) the output image will mix the colors by considering what effect the Alpha channel has of the base (top input socket) image. The Alpha channel of the output image is not affected.

Fac

The amount of mixing of the bottom socket is selected by the Factor input field (Fac:). A factor of zero does not use the bottom socket, where as a value of 1.0 makes full use. In Mix mode, 50:50 (0.50) is an even mix between the two, but in Add mode, .50 means that only half of the second socket's influence will be applied.

Examples

Below are samples of common mix modes and uses, mixing a color or checker with a mask.

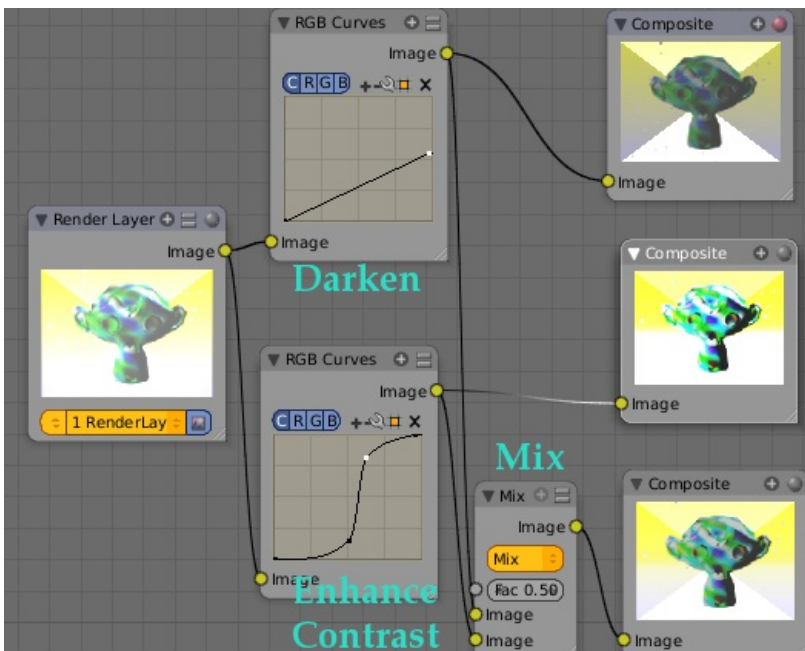


Some explanation of the mixing methods above might help you use the Mix node effectively:

- **Add** - adding blue to blue keeps it blue, but adding blue to red makes purple. White already has a full amount of blue, so it stays white. Use this to shift a color of an image. Adding a blue tinge makes the image feel colder.
- **Subtract**: Taking Blue away from white leaves Red and Green, which combined make Yellow (and you never thought you'd need a color wheel again, eh?). Taking Blue away from Purple leaves Red. Use this to de-saturate an image. Taking away yellow makes an image bluer and more depressing.
- **Multiply**: Black (0.00) times anything leaves black. Anything times White (1.00) is itself. Use this to mask out garbage, or to colorize a black-and-white image.
- **Hue**: Shows you how much of a color is in an image, ignoring all colors except what is selected: makes a monochrome picture (style 'Black & Hue').
- **Mix**: Combines the two images, averaging the two
- **Lighten**: Like bleach, makes your whites whiter. Use with a mask to lighten up a little.
- **Difference**: Kinda cute in that it takes out a color. The color needed to turn Yellow into White is Blue. Use this to compare two verry similar images to see what had been done to one to make it the other; sorta like a change log for images. You can use this to see a [watermark](#) you have placed in an image for theft detection.
- **Darken**, with the colors set here, is like looking at the world through rose-colored glasses (sorry, I just couldn't resist).

Contrast Enhancement using Mix

Here is a small map showing the effects of two other common uses for the RGB Curve: **Darken** and **Contrast Enhancement**. You can see the effect each curve has independently, and the combined effect when they are **mixed** equally.



Example node setup showing "Darken", "Enhance Contrast" and "Mix" nodes for composition.

As you can hopefully see, our original magic monkey was overexposed by too much light. To cure an overexposure, you must both darken the image and enhance the contrast. Other paint programs usually provide a slider type of control, but Blender, ah the fantastic Blender, provides a user-definable curve to provide precise control.

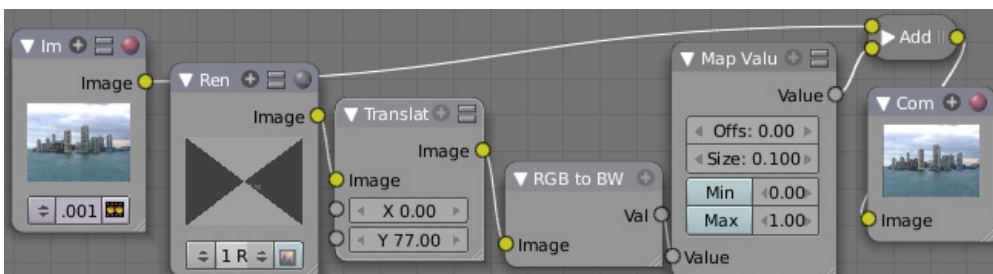
In the top RGB curve, *Darken*, only the right side of the curve was lowered; thus, any X input along the bottom results in a geometrically less Y output. The *Enhance Contrast* RGB 'S' curve scales the output such that middle values of X change dramatically; namely, the middle brightness scale is expanded, and thus whiter whites and blacker blacks are output. To make this curve, simply click on the curve and a new control point is added. Drag the point around to bend the curve as you wish. The Mix node combines these two effects equally, and Suzanne feels much better. And NOBODY wants a cranky monkey on their hands.

Using Mix to Watermark images

In the old days, a pattern was pressed into the paper mush as it dried, creating a mark that identified who made the paper and where it came from. The mark was barely perceptible except in just the right light. Probably the first form of subliminal advertising. Nowadays, people watermark their images to identify them as personal intellectual property, for subliminal advertising of the author or hosting service, or simply to track their image's proliferation throughout the web. Blender provides a complete set of tools for you to both encode your watermark and to tell if an image has your watermark.

Encoding Your Watermark in an Image

First, construct your own personal watermark. You can use your name, a word, a shape or image not easily replicated. While neutral gray works best using the encoding method suggested, you are free to use other colors or patterns. It can be a single pixel or a whole gradient; it's up to you. In the example below, we are encoding the watermark in a specific location in the image using the Translate node; this helps later because we only have to look in a specific location for the mark. We then use the RGB to BW node to convert the image to numbers that the Map Value node can use to make the image subliminal. In this case, it reduces the mark to one-tenth of its original intensity. The Add node adds the corresponding pixels, make the ones containing the mark ever-so-slightly brighter.



Embedding your mark in an Image using a Mark and Specific Position

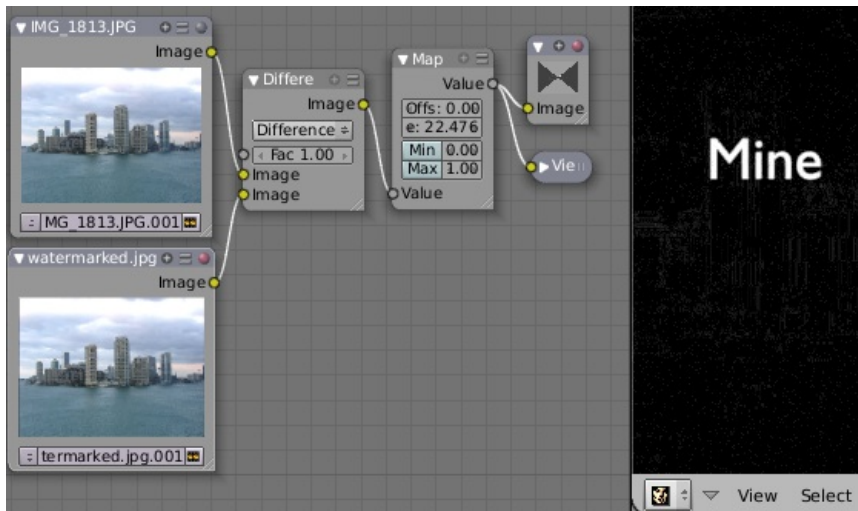
Of course, if you *want* people to notice your mark, don't scale it so much, or make it a contrasting color. There are also many other ways, using other mix settings and fancier rigs. Feel free to experiment!

Additional uses

You can also use this technique, using settings that result in visible effects, in title sequences to make the words appear to be cast on the water's surface, or as a special effect to make words appear on the possessed girl's forearm. yuk.

Decoding an Image for your Watermark

When you see an image that you think might be yours, use the node map below to compare it to your stock image (pre-watermarked original). In this map, the Mix node is set to Difference, and the Map Value node amplifies any difference. The result is routed to a viewer, and you can see how the original mark stands out, clear as a bell:



Checking an image for your watermark

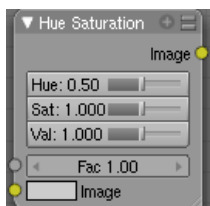
Various image compression algorithms lose some of the original; the difference shows as noise. Experiment with different compression settings and marks to see which works best for you by having the encoding map in one scene, and the decoding map in another. Use them while changing Blender's image format settings, reloading the watermarked image after saving, to get an acceptable result. In the example above, the mark was clearly visible all the way up to JPEG compression of 50%.

Using Dodge and Burn (History Lesson)

Use the dodge and burn mix methods in combination with a mask to affect only certain areas of the image. In the old darkroom days, when yes, I actually spent hours in a small stinky room bathed in soft red light, I used a circle cut out taped to a straw to dodge areas of the photo as the exposure was made, casting a shadow on the plate and thus limiting the light to a certain area.

To do the opposite, I would burn in an image by holding a mask over the image. The mask had a hole in it, letting light through and thus 'burning' in the image onto the paper. The same equivalent can be used here by mixing an alpha mask image with your image using a dodge mixer to lighten an area of your photo. Remember that black is zero (no) effect, and white is one (full) effect. And by the way, ya grew to like the smell of the fixer, and with a little soft music in the background and the sound of the running water, it was very relaxing. I kinda miss those days.

Hue Saturation Node



As an alternative to RGB editing, color can be thought of as a mix of Hues, namely a normalized value along the visible spectrum from infra-red to ultra violet (the rainbow, remember "Roy G. Biv"). The amount of the color added depends on the saturation of that color; the higher the saturation, the more of that pigment is added. Use the saturation slider of this node to "bring out" the colors of a washed out image.

This node takes an input image and runs the color of the image (and the light it reflects and radiates) 'up' through a factor (0.0-1.0) and applies a saturation of color effect of a hue to the image:

Hue:

The **Hue** slider specifies how much to shift the hue of the image. Hue 0.5 (in the middle) does not shift the hue or affect the color of the image. As Hue shifts left, the colors shift as more cyan is added; a blue image goes bluer, then greener, then yellow. A red image goes violet, then purple, blue, and finally teal. Shifting right (increasing Hue from 0.5 to 1.0) introduces reds and greens. A blue image goes purple, plum, red, orange, and then yellow. A red image goes golden, olive, green, and cyan.

Sat:

Saturation affect the amount of pigment in the image. A saturation of 0 actually *removes* hues from the color, resulting in a black-and-white grey scale image. A saturation of 1.0 blends in the hue, and 2.0 doubles the amount of pigment and brings out the colors.

Val:

Value affects the overall amount of the color in the image. Increasing value makes an image lighter; decreasing value shifts an image darker.

Fac:

Factor determines how much this node affects the image. A factor of 0 means that the input image is not affected by the Hue and Saturation settings. A factor of 1 means they rule, with .5 being a mix.

Hue Saturation tips

Some things to keep in mind, that might help you use this node better:

Hues are vice-versa.

A Blue image, with a Hue setting at either end of the spectrum (0 or 1), is output as yellow (Recall that white, minus blue, equals yellow). A Yellow image, with a Hue setting at 0 or 1, is blue.

Hue and Saturation work together.

So, a Hue of .5 keeps the blues the same shade of blue, but the saturation slider can deepen or lighten the intensity of that color.

Gray & White are a neutral hue.

A grey image, where the RGB values are equal, has no hue. Therefore, this node can only affect it with the Val slider. This applies for all shades of grey, from black to white; wherever the values are equal.

Changing the effect over time.

The Hue and Saturation values are set in the node by the slider, but you can feed a Time input into the Factor to bring up (or down) the effect change over time.

Tinge

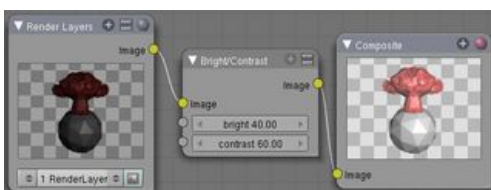
This HSV node simply shifts hues that are already there. To colorize a gray image, or to ADD color to an image, use a mix node to add in a static color from an RGB input node with your image.

HSV Example



Here, the image taken by a cheap digital camera in poor lighting at night using a flash (can we do it any worse, eh?) is adjusted by decreasing the Hue (decreasing reds and revealing more blues and greens), decreasing Saturation (common in digital cameras, and evens out contrast) and increasing Value (making it all lighter).

Bright/Contrast



A basic example

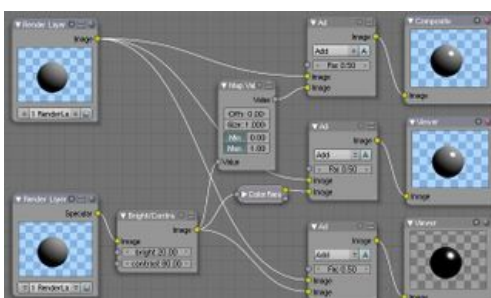
Bright

A multiplier-type factor by which to increase the overall brightness of the image. Use a negative number to darken an image.

Contrast

A scaling type factor by which to make brighter pixels brighter but keeping the darker pixels dark. Higher values make details stand out. Use a negative number to decrease the overall contrast in the image.

Notes



It is possible that this node will put out a value set that has values beyond normal range, i.e. values > 1 or < 0 . If you will be using the output to mix with other images in the normal range, you should clamp the values using the Map Value node (with the Min and Max enabled), or put through a ColorRamp node (with all normal defaults).

Either of these nodes will scale the values back to normal range. In the example image, we want to amp up the specular pass. The bottom thread shows what happens if we do not clamp the values; the specular pass has values much less than 1 in the dark areas; when added to the medium gray, it makes black. Passing the brightened image through either the Map Value or the ColorRamp produces the desired effect.

Gamma

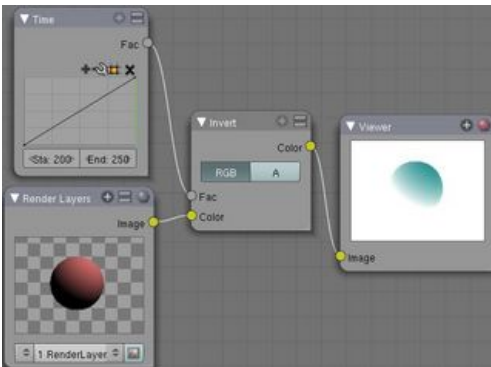


The reason for applying gamma correction to the final render is to correct lighting issues. Lighting issues that are corrected by the gamma correction are light attenuation with distance, light falloff at terminators and light and shadows superpositions. Simply think about the renderer as a virtual camera. By applying a gamma correction to your render, you are just replicating what digital camera do with the photos. Digital camera gamma correct their photos so you do the same thing. The gamma correction is, indeed, 0.45. Not 2.2.

But the reverse gamma correction on the textures and colors have another very important consequence when you are using rendering techniques such as radiosity or GI. When doing the GI calculations, all textures and colors are taken to mean reflectance. If you do not reverse gamma correct your textures and colors, then the GI render will look way too bright because the reflected colors are all way too high and thus a lot more light is bouncing around than it should.

Gamma correction in Blender enters in a few places. The first is in this section with the nodes, both this node and the Tonemap node, and the second is in calculating Radiosity. In the noodle to the left, the split viewer shows the before and after effect of applying a gamma correction.

Invert



This handy node inverts the colors in the input image, producing a negative.

Options

Factor

Controls the amount of influence the node exerts on the output image

Color

The input image. In this case, a red sphere on a black transparent background

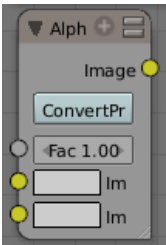
RGB

Invert the colors from white. In this example, red inverted is cyan (teal).

A

Invert the alpha (transparency) channel as well. Handy for masking.

AlphaOver Node



AlphaOver
node

Use this node to layer images on top of one another. This node takes two images as input, combines them by a factor, and outputs the image. Connect the Background image to the top input, and the foreground image to the lower input. Where the foreground image pixels have an alpha greater than 0 (namely, have some visibility), the background image will be overlaid.

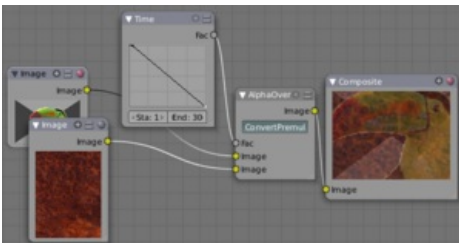
Use the Factor slider to 'merge' the two pictures. A factor less than 1.00 will make the foreground more transparent, allowing the background to bleed through.

Examples



Assembling a composite Image using
AlphaOver

In this example, an image of a Toucan is superimposed over a wooden background. Use the PreMultiply button when the foreground image and background images have a combined Alpha that is greater than 1.00; otherwise you will see an unwanted halo effect. The resulting image is a composite of the two source images.



Animated See-Through/Sheer SFX using
AlphaOver - Frame 11

In this example, we use the Factor control to make a sheer cloth or onion-skin effect. You can animate this effect, allowing the observer to 'see-through' walls (or any foreground object) by hooking up a Time node to feed the Factor socket as shown below. In this example, over the course of 30 frames, the Time node makes the AlphaOver node produce a picture that starts with the background wood image, and slowly bleeds through the Toucan. This example shows frame 11 just as the Toucan starts to be revealed. AlphaOver does not work on the colors of an image, and will not output any image when one of the sockets is unconnected.

Strange Halos or Outlines

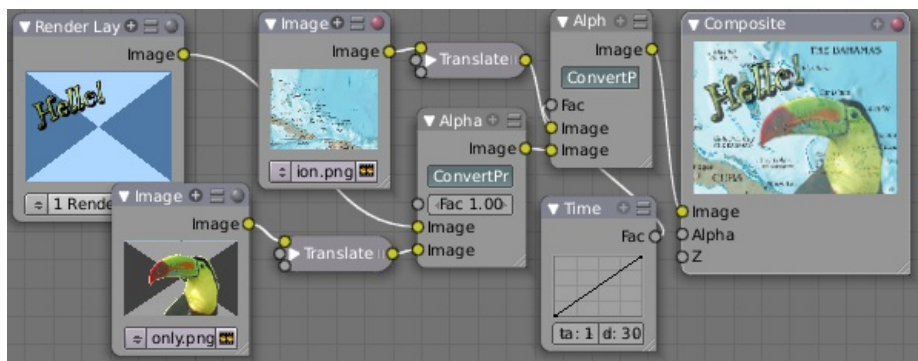
To clarify the premultiplied-alpha button: An alpha channel has a value of between 0 and 1. When you make an image transparent (to composite it over another one), you are really multiplying the RGB pixel values by the alpha values (making the image transparent (0) where the alpha is black (0), and opaque (1) where it is white (1)).

So, to composite image A over image B, you get the alpha of image A and multiply it by image A, thus making the image part of A opaque and the rest transparent. You then inverse the alphas of A and multiply image B by it, thus making image B transparent where A is opaque and vice versa. You then add the resultant images and get the final composite.

A pre-multiplied alpha is when the image (RGB) pixels are already multiplied by the alpha channel, therefore the above compositing op doesn't work too well, and you have to hit 'convert pre-mul'. This is only an issue in semi transparent area, and edges usually. The issue normally occurs in Nodes when you have combined, with alpha, two images, and then wish to combine that image with yet another image. The previously combined image was previously multiplied (pre-mul) and needs to be converted as such (hence, *Convert PreMul*).

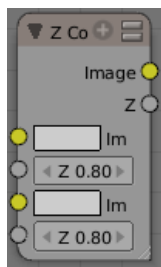
If you don't pay attention and multiply twice, you will get a white or clear halo around your image where they meet, since your alpha

value is being squared or cubed. It also depends on whether or not you have rendered your image as a pre-mult, or straight RGBA image.



Layering Images using AlphaOver Premul

Z-Combine Node



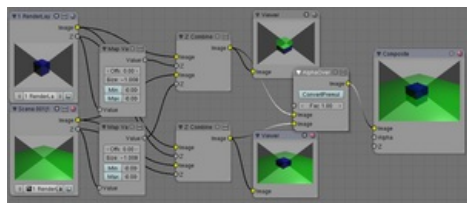
Z Combine node

The Z-Combine node takes two images and two Z-value sets as input. It overlays the images using the provided Z values to detect which parts of one image are in front of the other. If both Z values are equal, it uses the top image. It puts out the combined image, with the combined Z-depth map, allowing you to thread multiple Z-combines together.

Z-Combine chooses whichever Z-value is less when deciding which image pixel to use. Normally, objects are in front of the camera and have a positive Z value. If one Z-value is negative, and the other positive, Z-Combine will use the image corresponding to the negative value. You can think of a negative Z value as being behind the camera. When choosing between two negative Z-values, Z-Combine will use whichever is more negative.

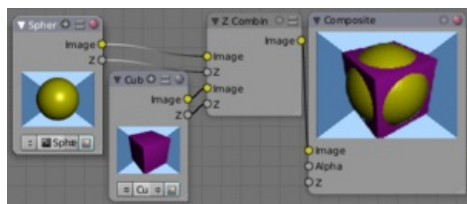
Alpha values carry over from the input images. Not only is the image pixel chosen, but also its alpha channel value. So, if a pixel is partially or totally transparent, the result of the Z-Combine will also be partially transparent; in which case the background image will show through the foreground (chosen) pixel. Where there are sharp edges or contrast, the alpha map will automatically be anti-aliased to smooth out any artifacts.

However, you can obtain this by making an AlphaOver of two Z-Combine, one normal, the other having inverted (reversed?) Z-values as inputs, obtained using for each of them a MapValue node with a Size field set to -1.0:



Alpha and Z-Combine node.

Examples



Choosing closest pixels

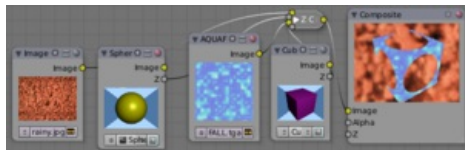
In the example to the right, render output from two scenes are mixed using the Z-Offset node, one from a sphere of size 1.30, and the other a cube of size 1.00. The sphere and square are located at the same place. The cube is tipped forward, so the corner in the center is closer to the camera than the sphere surface; so Z-Offset chooses to use the cube's pixels. But the sphere is slightly larger (a size of 1.30 versus 1.00), so it does not fit totally 'inside' the cube. At some point, as the cube's sides recede back away from the

camera, the sphere's sides are closer. When this happens, Z-offset uses the sphere's pixels to form the resulting picture.

This node can be used to combine a foreground with a background matte painting. Walt Disney pioneered the use of multi-plane mattes, where three or four partial mattes were painted on glass and placed on the left and right at different Z positions; minimal camera moves to the right created the illusion of depth as Bambi moved through the forest.

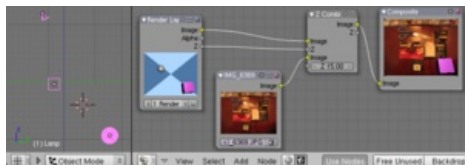
Valid Input

Z Input Sockets do not accept fixed values; they must get a vector set (see Map Value node). Image Input Sockets will not accept a color, since it does not have UV coordinates.



Mix and Match Images

You can use Z-Combine to merge two images as well, using the Z-values put out by two renderlayers. Using the Z-values from the sphere and cube scenes above, but threading different images, yields the example to the right.



Z-Combine in action

In this noodle (you may click the little expand-o-matic icon in the bottom right to view it to full size), we mix a render scene with a flat image. In the side view of the scene, the purple cube is 10 units away from camera, and the gray ball is 20. The 3D cursor is about 15 units away from camera. We Z-in the image at a location of 15, thus inserting it in-between the cube and the ball. The resulting image appears to have the cube on the table.

Invisible Man Effect

If you choose a foreground image which has a higher Alpha than the background, and then mix the Z-combine with a slightly magnified background, the outline of the transparent area will distort the background, enough to make it look like you are seeing part of the background through an invisible yet Fresnel-lens object.

Color Balance

The Color Balance node can adjust the color and values of an image using two different correction formulas.

The Lift, Gamma, Gain formula uses Lift, Gamma, and Gain calculations to adjust an image. Lift increases the value of dark colors, Gamma will adjust midtones, and Gain adjusts highlights.

The Offset, Power, Slope formula uses Offset, Power, and Slope

$$\text{out} = (i * s + o) ^ p,$$

where

- out = the color graded pixel code value
- i = the input pixel code value (0=black, 1=white)
- s = slope (any number 0 or greater, nominal value is 1.0)
- o = offset (any number, nominal value is 0)
- p = power (any number greater than 0, nominal value is 1.0)

Factor

Controls the amount of influence the node exerts on the output image

Hue Correct

The Hue Correct node is able to adjust the Hue, Saturation, and Value of an image, with an input curve.

By default, the curve is a straight line, meaning there is no change. The spectrum allows you to raise or lower HSV levels for each range of pixel colors. To change a H, S, or V level, move the curve points up or down. Pixels with hue values each point in the horizontal position of the graph will be changed depending on the shape of the curve.

Tone Map

Tone mapping is a technique used in image processing and computer graphics to map one set of colors to another in order to approximate the appearance of high dynamic range images in a medium that has a more limited dynamic range.

Essentially, tone mapping addresses the problem of strong contrast reduction from the scene values (radiance) to the displayable range while preserving the image details and color appearance important to appreciate the original scene content.

The Tone Map node has two methods of calculation:

Rh Simple

Key

The value the average luminance is mapped to.

Offset

Normally always 1, but can be used as an extra control to alter the brightness curve

Gamma

If not used, set to 1

R/D Photoreceptor

Intensity

If less than zero, darkens image; otherwise, makes it brighter

Contrast

Set to 0 to use estimate from input image

Adaptation

If 0, global; if 1, based on pixel intensity

Color Correction

If 0, same for all channels; if 1, each independent

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Proposed fixes: none

Composite Vector Nodes

Vector Nodes

Vector nodes manipulate information about how light interacts with the scene, multiplying vector sets, and other wonderful things that normal humans barely comprehend (except math geniuses, who may not be considered 'normal'). Even if you aren't a math wiz, you'll find these nodes to be very useful.

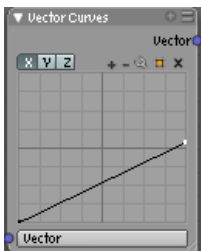
Vectors, in general, are two or three element values, for example, RGB color value, and surface normals are vectors. Vectors are also important for calculating shading.

Normal Node

The Normal node generates a normal vector and a dot product. Click and Drag on the sphere to set the direction of the normal.

This node can be used to input a new normal vector into the mix. For example, use this node as an input to a Color Mix node. Use an Image input as the other input to the Mixer. The resulting colored output can be easily varied by moving the light source (click and dragging the sphere).

Vector Curves Node

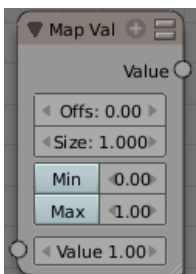


The Vector Curves node maps an input vector image's x, y, and z components to a diagonal curve. The three channels are accessed via the X, Y, and Z buttons at the top of the node. Add points to the curve by clicking on it.

Note that dragging a point across another will switch the order of the two points (e.g. if point A is dragged across point B, then point B will become point A and point A will become point B).



Use this curve to slow things down or speed them up from the original scene.

Map Value Node



Map Value node

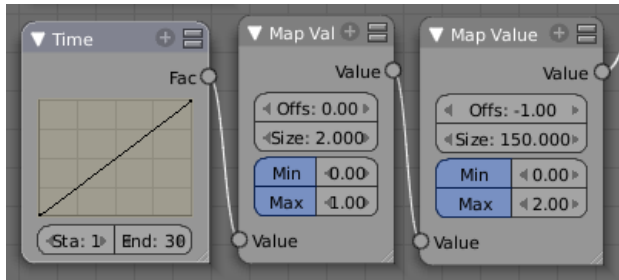
Map Value node is used to scale, offset and clamp values (value refers to each vector in the set). The formula for how this node works is:

- Offs will add a number to the input value
- Size will scale (multiply) that value by a number
- By clicking Min/Max you can set the minimum and maximum numbers to clamp (cut off) the value too. Min and Max must be individually enabled by LMB  clicking on the label for them to clamp. ⇧ Shift LMB  on the value to change it.
- If Min is enabled and the value is less than Min, set the output value to Min

- If Max is enabled and the input value is greater than Max, set the output value to Max

This is particularly useful in achieving a depth-of-field effect, where you can use the Map Value node to map a Z value (which can be 20 or 30 or even 500 depending on the scene) to a range between 0-1, suitable for connecting to a Blur node.

Using Map Value to Multiply values



You can also use the map value node to multiply values to achieve an output number that you desire. In the mini-map to the right, the Time node outputs a value between 0.00 and 1.00 evenly scaled over 30 frames. The *first* Map Value node multiplies the input by 2, resulting in an output value that scales from 0.00 to 2.00 over 30 frames. The *second* Map Value node subtracts 1 from the input, giving working values between -1.00 and 1.00, and multiplies that by 150, resulting in an output value between -150 and 150 over a 30-frame sequence.

Normalize

Normalizing a vector scales its magnitude, or length, to a value of 1, but keeps its direction intact.

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Proposed fixes: none

Composite Filter Nodes

Filters process the pixels of an image to highlight additional details or perform some sort of post-processing effect on the image.

Filter Node



Filter node

The Filter node implements various common image enhancement filters. The supported filters are, if not obvious, named after the mathematical genius who came up with them:

Soften

Slightly blurs the image.

Sharpen

Increases the contrast, especially at edges

Laplace

Softens around edges

Sobel

Creates a negative image that highlights edges

Prewitt

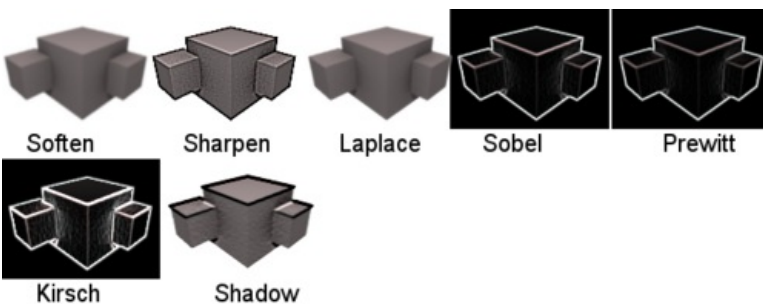
Tries to do Sobel one better.

Kirsch

Improves on the work done by those other two flunkies, giving a better blending as you approach an edge.

Shadow

Performs a relief emboss/bumpmap effect, darkening outside edges.



☐ The Filter node has seven modes, shown here.

The Soften, Laplace, Sobel, Prewitt and Kirsch all perform edge-detection (in slightly different ways) based on vector calculus and set theory equations that would fill six blackboards with gobbledy gook. Recommended reading for insomniacs.

Blur Node



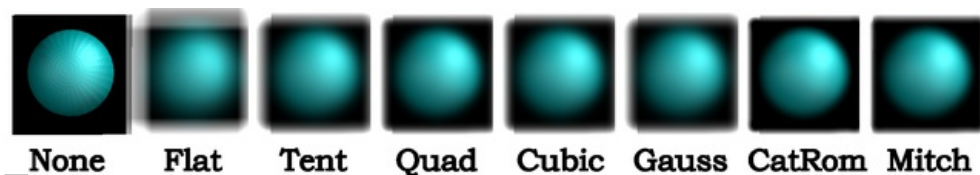
Blur node

The Blur node blurs an image, using one of seven blur modes (set using the upper-left popup button), and a radius defined by the X and Y number buttons. By default these are set to zero, so to enable the node you must set one or both to a value greater than 0. You can optionally connect a value image to the Size input node, to control the blur radius with a mask. The values must be mapped between 0-1 for best effect, as they will be multiplied with the X and Y number button values.

Options

The X and Y values are the number of pixels over which to spread the blur effect.

The Bokeh button (only visible as Bok or Bo on some screen setups) will force the blur node to use a circular blur filter. This gives higher quality results, but is slower than using a normal filter. The Gamma button (for "gamma") makes the Blur node gamma-correct the image before blurring it.



☐ Blur node blur modes using 15% of image size as XY, no Bokeh/Gamma. Click expand to see details

The difference between them is how they handle sharp edges and smooth gradients and preserve the highs and the lows. In particular (and you may have to closely examine the full-resolution picture to see this):

- Flat just blurs everything uniformly
- Tent preserves the high and the lows better making a linear falloff
- Quadratic and CatRom keep sharp-contrast edges crisp
- Cubic and Mitch preserve the highs but give almost a out-of-focus blur while smoothing sharp edges

Directional Blur Node

Blurs an image in a specified direction and magnitude. Can be used to fake motion blur.

Options

Iterations

Controls how many times the image is duplicated to create the blur effect. Higher values give smoother results.

Wrap

Wraps the image on the X and Y axis to fill in areas that become transparent from the blur effect.

Center

Sets the position where the blur center is. This makes a difference if the angle, spin, and/or zoom are used.

Distance

How large the blur effect is.

Angle

Image is blurred at this angle from the center

Spin

Rotates the image each iteration to create a spin effect, from the center point.

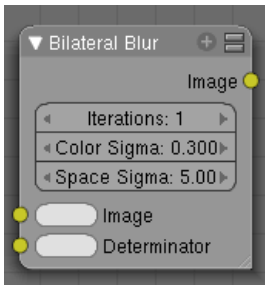
Zoom

Scales the image each iteration, creating the effect of a zoom.

Example

An example blend file, in fact the one used to create the image above, [is available here](#). The .blend file takes one image from the RenderLayer "Blurs" and blurs it while offsetting it (Translate) and then combining it (AlphaOver) to build up the progressive sequence of blurs. Play with the Value and Multiply nodes to change the amount of blurring that each algorithm does.

Bilateral Blur Node



Blur node

The bilateral blur node performs a high quality adaptive blur on the source image. It can be used for various purposes like:

- smoothing results from blenders raytraced ambient occlusion
- smoothing results from various unbiased renderers,
- to fake some performance-heavy processes, like blurry refractions/reflections, soft shadows,
- to make non-photorealistic compositing effects.

Inputs

Bilateral blur has 2 inputs:

- Image, for the image to be blurred.
- Determinator, which is non-obligatory, and is used only if connected.

if only 1st input is connected, the node blurs the image depending on the edges present in the source image. If the Determinator is connected, it serves as the source for defining edges/borders for the blur in the image. This has great advantage in case the source image is too noisy, but normals in combination with zbuffer can still define exact borders/edges of objects.

Options

Iterations

Defines how many times the filter should perform the operation on the image. It practically defines the radius of blur.

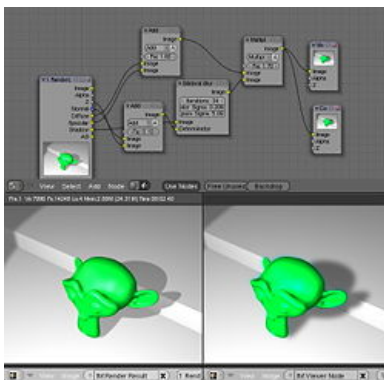
Color Sigma

Defines the threshold for which color differences in the image should be taken as edges.

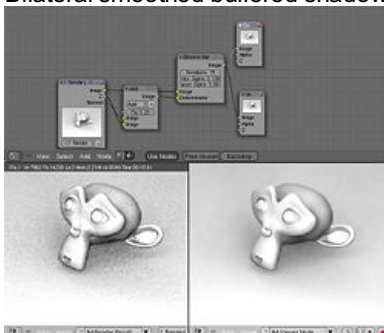
Space sigma

A fine-tuning variable for blur radius.

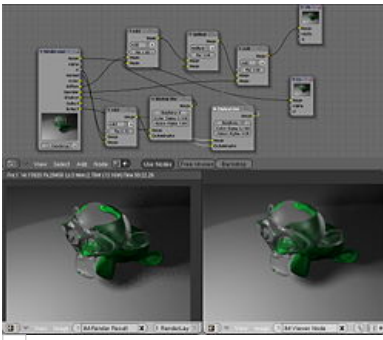
Examples



Bilateral smoothed buffered shadow

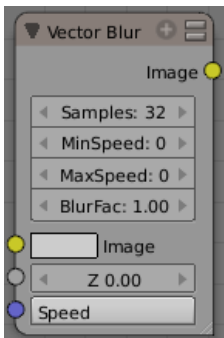


Bilateral smoothed AO



Bilateral faked blurry
refraction+smoothed reytaced soft
shadow

Vector (Motion) Blur Node



Vector Blur node

Motion blur is the effect of objects moving so fast they blur. Because CG animations work by rendering individual frames, they have no real knowledge of what was where in the last frame, and where it is now.

In Blender, there are two ways to produce motion blur. The first method (which produces the most correct results) works by rendering a single frame up to 16 times with slight time offsets, then accumulating these images together; this is called Motion Blur and is activated on the Render panel. The second (and much faster) method is the Compositor node Vector Blur.

To use, connect the appropriate passes from a Render Result node.

Note

Make sure to enable the Speed (called Vec) pass in the Render Layers panel for the render layer you wish to perform motion blur on.

Maximum Speed: Because of the way vector blur works, it can produce streaks, lines and other artifacts. These mostly come from pixels moving too fast; to combat these problems, the filter has minimum and maximum speed settings, which can be used to limit which pixels get blurred (e.g. if a pixel is moving really, really fast but you have maximum speed set to a moderate amount, it won't get blurred).

Minimum Speed: Especially when the camera itself moves, the mask created by the vectorblur node can become the entire image. A very simple solution is to introduce a small threshold for moving pixels, which can efficiently separate the hardly-moving pixels from the moving ones, and thus create nice looking masks. You can find this new option as 'min speed'. This minimum speed is in pixel units. A value of just 3 will already clearly separate the background from foreground.

Hint

You can make vector blur results a little smoother by passing the Speed pass through a blur node (but note that this can make strange results, so it's only really appropriate for still images with lots of motion blur).

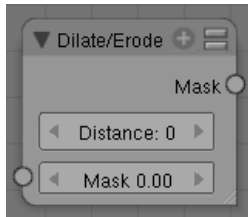
Examples

An in-depth look at how to use the Vector Blur node [can be found here](#).

As far as we know, this node represents a [new approach to calculating motion blur](#). Use vector blur in compositing with confidence instead of motion blur. In face, when compositing images, it is necessary to use vector blur since there isn't "real" motion. In this [example blend file](#), you will find a rigged hand reaching down to pick up a ball. Based on how the hand is moving (those vectors), the image is blurred in that direction. The fingers closest to the camera (the least Z value) are blurred more, and those farther away (the forearm) is blurred the least.

Known Bugs

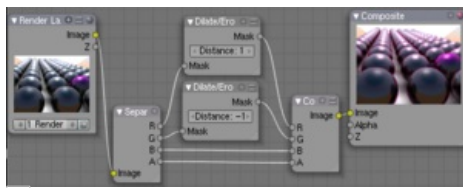
Dilate/Erode Node



Dilate/Erode node

This node blurs individual color channels. The color channel (or a black and white image) is connected to the Mask input socket, and the Distance is set manually (by clicking on the arrows or the value) or automatically from a value node or a time-and-map-value noodle. A positive value of Distance expands the influence of a pixel on its surrounding pixels, thus blurring that color outward. A negative value erodes its influence, thus increases the contrast of that pixel relative to its surrounding pixels, thus sharpening it relative to surrounding pixels of the same color.

Example



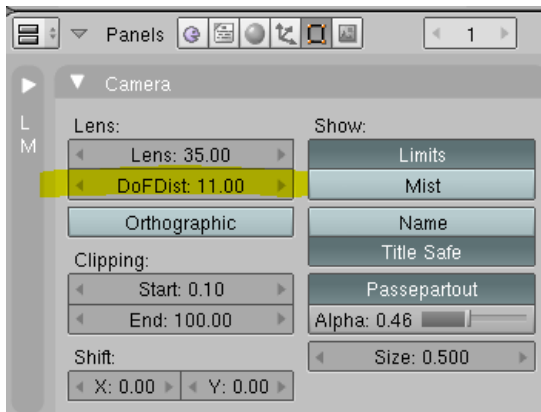
Magenta tinge

In the above example image, we wanted to take the rather boring array of ball bearings and spruce it up; make it hot, baby. So, we dilated the red and eroded the green, leaving the blue alone. If we had dilated both red and green...(hint: red and green make yellow). The amount of influence is increased by increasing the Distance values. [Blend file available here.](#)

Defocus

This single node can be used to emulate depth of field using a postprocessing method. It can also be used to blur the image in other ways, not necessarily based on 'depth' by connecting something other than a Zbuffer. In essence, this node blurs areas of an image based on the input zbuffer map/mask.

Camera Settings



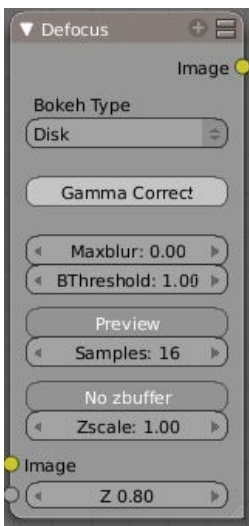
DofDist setting for the camera.

The Defocus node uses the actual camera data in your scene if supplied by a RenderLayer node.

To set the point of focus, the camera now has a DoFDist parameter, which is shorthand for Depth of Field Distance. Use this camera parameter to set the focal plane of the camera (objects DoFDist away from the camera are in focus). Set DofDist in the main Camera edit panel; the button is right below the Lens value button.

To make the focal point visible, enable the camera Limits option, the focal point is then visible as a yellow cross along the view direction of the camera.

Node Inputs



Defocus node

The node requires two inputs, an image and a zbuffer, the latter does not need to be an actual zbuffer, but can also be another (grayscale) image used as mask, or a single value input, for instance from a time node, to vary the effect over time.

Node Setting

The settings for this node are:

Bokeh Type menu

Here you set the number of iris blades of the virtual camera's diaphragm. It can be set to emulate a perfect circle (Disk) or it can be set to have 3 (Triangle), 4 (Square), 5 (Pentagon), 6 (Hexagon), 7 (Heptagon) or 8 blades (Octagon). The reason it does not go any higher than 8 is that from that point on the result tends to be indistinguishable from a Disk shape anyway.

Rotate

This button is not visible if the Bokeh Type is set to Disk. It can be used to add an additional rotation offset to the Bokeh shape. The value is the angle in degrees.

Gamma Correct

Exactly the same as the Gamma option in Blender's general Blur node (see [Blur Node](#)). It can be useful to further brighten out of focus parts in the image, accentuating the Bokeh effect.



Defocus node using Z-Buffer

fStop

This is the most important parameter to control the amount of focal blur: it simulates the aperture f of a real lens(' iris) - without modifying the luminosity of the picture, however! As in a real camera, the *smaller* this number is, the more-open the lens iris is, and the *shallower* the depth-of-field will be. The default value 128 is assumed to be infinity: everything is in perfect focus. Half the value will double the amount of blur. This button is not available if No zbuffer is enabled.

Maxblur

Use this to limit the amount of blur of the most out of focus parts of the image. The value is the maximum blur radius allowed.

This can be useful since the actual blur process can sometimes be very slow. (The more blur, the slower it gets.) So, setting this value can help bring down processing times, like for instance when the world background is visible, which in general tends to be the point of maximum blur (not always true, objects very close to the lens might be blurred even more). The default value of 0 means there is no limit to the maximum blur amount.

BThreshold

The defocus node is not perfect: some artifacts may occur. One such example is in-focus objects against a blurred background, which have a tendency to bleed into the edges of the sharp object. The worst-case scenario is an object in-focus against the very distant world background: the differences in distance are very large and the result can look quite bad. The node tries to prevent this from occurring by testing that the blur difference between pixels is not too large, the value set here controls how large that blur difference may be to consider it 'safe.' This is all probably quite confusing, and fortunately, in general, there is no need to change the default setting of 1. Only try changing it if you experience problems around any in-focus object.

Preview

As already mentioned, processing can take a long time. So to help make editing parameters somewhat 'interactive', there is a preview mode which you can enable with this button. Preview mode will render the result using a limited amount of (quasi)random samples, which is a *lot* faster than the 'perfect' mode used otherwise. The sampling mode also tends to produce grainy, noisy pictures (though the more samples you use, the less noisy the result). This option is on by default. Play around with the other parameters until you are happy with the results, and only then disable the preview mode for the final render.

Samples

Only visible when Preview is set. Sets the amount of samples to use to sample the image. The higher, the smoother the image, but also the longer the processing time. For preview, the default of 16 samples should be sufficient and is also the fastest.

No zbuffer

Sometimes you might want to have more control to blur the image. For instance, you may want to only blur one object while leaving everything else alone (or the other way around), or you want to blur the whole image uniformly all at once. The node therefore allows you to use something other than an actual zbuffer as the Z input. For instance, you could connect an image node and use a grayscale image where the color designates how much to blur the image at that point, where white is maximum blur and black is no blur. Or, you could use a Time node to uniformly blur the image, where the time value controls the maximum blur for that frame. It may also be used to obtain a possibly slightly-better DoF blur, by using a fake depth shaded image instead of a zbuffer. (A typical method to create the fake depth shaded image is by using a linear blend texture for all objects in the scene or by using the 'fog/mist' fake depth shading method.) This also has the advantage that the fake depth image can have anti-aliasing, which is not possible with a real zbuffer. "No zbuffer" will be enabled automatically whenever you connect a node that is not image based (e.g. time node/value node/etc).

Zscale

Only visible when No zbuffer enabled. When No zbuffer is used, the input is used directly to control the blur radius. And since usually the value of a texture is only in the numeric range 0.0 to 1.0, its range is too narrow to control the blur properly. This parameter can be used to expand the range of the input (or for that matter, narrow it as well, by setting it to a value less than one). So for No zbuffer, this parameter therefore then becomes the main blur control (similar to fStop when you *do* use a zbuffer).

Examples



In this [blend file example](#), the ball array image is blurred as if it was taken by a camera with a f-stop of 2.8 resulting in a fairly narrow depth of field centered on 7.5 blender units from the camera. As the balls recede into the distance, they get blurrier.

Hints

Preview

In general, use preview mode, change parameters to your liking, only then disable preview mode for the final render. This node is compute intensive, so watch your console window, and it will give you status as it computes each render scan line.

Edge Artifacts

For minimum artifacts, try to setup your scene such that differences in distances between two objects that may visibly overlap at some point are not too large.

"Focus Pull"

Keep in mind that this is not 'real' DoF, only a post-processing simulation. Some things cannot be done which would be no problem for real DoF at all. A typical example is a scene with some object very close to the camera, and the camera focusing on some point far behind it. In the real world, using shallow depth of field, it is not impossible for nearby objects to become completely invisible, in effect allowing the camera to see 'behind' it. Hollywood cinematographers use this visual characteristic to good effect to achieve the popular "focus pull" effect, where the focus shifts from a nearby to a distant object, such that the

"other" object all but disappears. Well, this is simply not possible to do with the current post-processing method in a single pass. If you really want to achieve this effect, quite satisfactorily, here's how:

- Split up your scene into "nearby" and "far" objects, and render them in two passes.
- Now, combine the two the two results, each with their own "defocus" nodes driven by the same Time node, but with one of them inverted. (e.g. using a "Map Value" node with a Size of -1.) As the defocus of one increases, the defocus on the other decreases at the same rate, creating a smooth transition.

Aliasing at Low f-Stop Values

At very low values, less than 5, the node will start to remove any oversampling and bring the objects at DoFDist very sharply into focus. If the object is against a contrasting background, this may lead to visible stairstepping (aliasing) which OSA is designed to avoid. If you run into this problem:

- Do your own OSA by rendering at twice the intended size and then scaling down, so that adjacent pixels are blurred together
- Use the blur node with a setting of 2 for x and y
- Set DoFDist off by a little, so that the object in focus is blurred by the tiniest bit.
- Use a higher f-Stop, which will start the blur, and then use the Z socket to a Map Value to a Blur node to enhance the blur effect.
- Rearrange the objects in your scene to use a lower-contrast background

No ZBuffer

A final word of warning, since there is no way to detect if an actual zbuffer is connected to the node, be VERY careful with the "No ZBuffer" switch. If the Zscale value happens to be large, and you forget to set it back to some low value, the values may suddenly be interpreted as huge blur-radius values that will cause processing times to explode.

Copy This page is a copy of the same page in 2.4 manual, need to be updated


Proposed fixes: none

Composite Convertor Nodes


As the name implies, these nodes convert the colors or other properties of various data (e.g. images) in some way. They also split out or re-combine the different color channels that make up an image, allowing you to work on each channel independently. Various color channel arrangements are supported, including traditional RGB and HSV formats, and the newest High Definition Media Interface (HDMI) formats.

ColorRamp Node

The ColorRamp Node is used for mapping values to colors with the use of a gradient. It works exactly the same way as a [colorband for textures and materials](#), using the Factor value as a slider or index to the color ramp shown, and outputting a color value and an alpha value from the output sockets.

By default, the ColorRamp is added to the node map with two colors at opposite ends of the spectrum. A completely black black is on the left (Black as shown in the swatch with an Alpha value of 1.00) and a whitewash white is on the right. To select a color, LMB  click on the thin vertical line/band within the colorband. The example picture shows the black color selected, as it is highlighted white. The settings for the color are shown above the colorband as (left to right): color swatch, Alpha setting, and interpolation type.

To change the hue of the selected color in the colorband, LMB  click on the swatch, and use the popup color picker control to select a new color. Press **↵** Enter to set that color.

To add colors, hold Ctrl down and Ctrl LMB  click inside the gradient. Edit colors by clicking on the rectangular color swatch, which pops up a color-editing dialog. Drag the gray slider to edit Alpha values. Note that you can use textures for masks (or to simulate the old "Emit" functionality) by connecting the alpha output to the factor input of an RGB mixer.

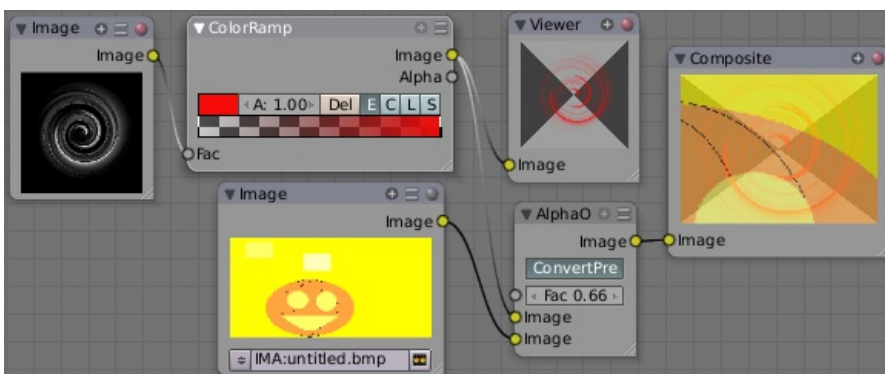
To delete a color from the colorband, select it and press the Delete button.

When using multiple colors, you can control how they transition from one to another through an interpolation mixer. Use the interpolation buttons to control how the colors should band together: Ease, Cardinal, Linear, or Spline.

Use the A: button to define the Alpha value of the selected color for each color in the range.

Using ColorRamp to create an Alpha Mask

A powerful but often overlooked feature of the ColorRamp is to create an Alpha Mask, or a mask that is overlaid on top of another image, and, like a mask, allows some of the background to show through. The example map below shows how to use the Color Ramp node to do this:



Using the ColorRamp node to create an alpha mask

In the map above, a black and white swirl image, which is lacking an alpha channel, is fed into the ColorRamp node as a Factor. (Technically, we should have converted the image to a value using the RGB-to-BW node, but hey, this works just as well since we are using a BW image as input.)

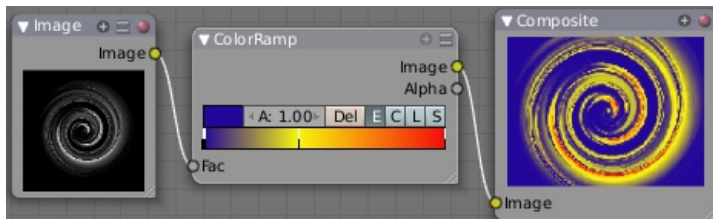
We have set the ColorRamp node to a purely transparent color on the left end of the spectrum, and a fully Red color on the right. As seen in the viewer, the ColorRamp node puts out a mask that is fully transparent where the image is black. Black is zero, so ColorRamp uses the 'color' at the left end of the spectrum, which we have set to transparent. The ColorRamp image is fully red and opaque where the image is white (1.00).

We verify that the output image mask is indeed transparent by overlaying it on top of a pumpkin image. For fun, we made that

AlphaOver output image 0.66 transparent so that we can, in the future, overlay the image on a flashing white background to simulate a scary scene with lighting flashes.

Using ColorRamp to Colorize an Image

The real power of ColorRamp is that multiple colors can be added to the color spectrum. This example compositing map takes a boring BW image and makes it a flaming swirl!

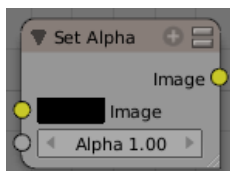


In this example, we have mapped the shades of gray in the input image to three colors, blue, yellow, and red, all fully opaque (Alpha of 1.00). Where the image is black, ColorRamp substitutes blue, the currently selected color. Where it is some shade of gray, ColorRamp chooses a corresponding color from the spectrum (bluish, yellow, to redish). Where the image is fully white, ColorRamp chooses red.

RGB to BW Node

This node converts an RGB input and outputs a greyscale image.

Set Alpha Node



Set Alpha node

This node adds an alpha channel to a picture. Some image formats, such as JPEG, do not support an alpha channel. In order to overlay a JPEG image on top of a background, you must add an alpha channel to it using this node.

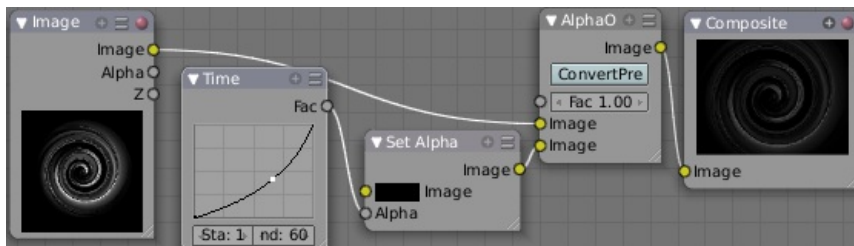
The Image input socket is optional. If an input image is not supplied, the base color shown in the swatch will be used. To change the color, LMB click the swatch and use the color-picker control to choose or specify a color you want.

The amount of Alpha (1.00 being totally opaque and 0.00 being totally transparent) can be set for the whole picture using the input field. Additionally, the Alpha factor can be set by feeding its socket.

Note that this is not, and is not intended to be, a general-purpose solution to the problem of compositing an image that doesn't contain Alpha information. You might wish to use "Chroma Keying" or "Difference Keying" (as discussed elsewhere) if you can. This node is most often used (with a suitable input being provided by means of the socket) in those troublesome cases when you *can't*, for some reason, use those techniques directly.

Using SetAlpha to Fade to Black

To transition the audience from one scene or shot to another, a common technique is to "fade to black". As its name implies, the scene fades to a black screen. You can also "fade to white" or whatever color you wish, but black is a good neutral color that is easy on the eyes and intellectually "resets" the viewer's mind. The node map below shows how to do this using the Set Alpha node.



Fade To Black

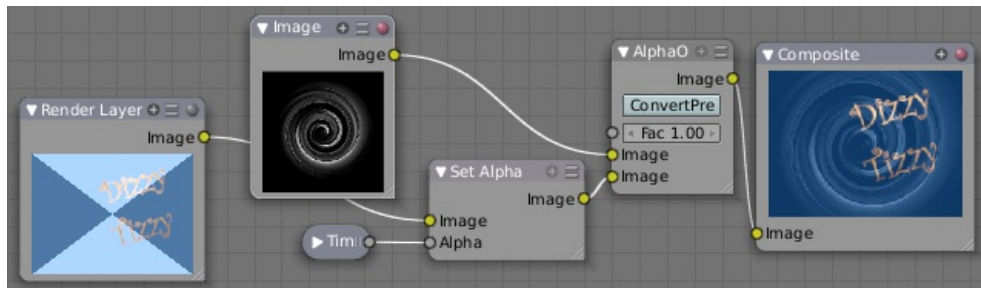
In the example above, the alpha channel of the swirl image is ignored. Instead, a [time node](#) introduces a factor from 0.00 to 1.00 over 60 frames, or about 2 seconds, to the Set Alpha node. Note that the time curve is exponentially-shaped, so that the overall blackness will fade in slowly and then accelerate toward the end. The Set Alpha node does not need an input image; instead the flat (shadeless) black color is used. The Set Alpha Node uses the input factor and color to create a black image that has an alpha set which goes from 0.00 to 1.00 over 60 frames, or completely transparent to completely opaque. Think of alpha as a multiplier for how vivid you can see that pixel. These two images are combined by our trusty AlphaOver node completely (a Factor of 1.00) to produce the composite

image. The SetAlpha node will thus, depending on the frame being rendered, produce a black image that has some degree of transparency. Set up and Animate, and you have an image sequence that fades to black over a 2-second period.

No Scene information used
This example node map does not use the RenderLayer. To produce this 2 second animation, no blender scene information was used. This is an example of using Blender's powerful compositing abilities separate from its modeling and animation capabilities. (A Render Layer could be substituted for the Image layer, and the "fade-network" effect will still produce the same effect)

Using SetAlpha to Fade In a Title

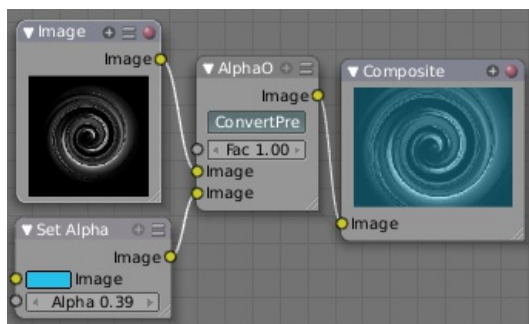
To introduce your animation, you will want to present the title of your animation over a background. You can have the title fly in, or fade it in. To fade it in, use the SetAlpha node with the Time node as shown below.



Using Set Alpha to Fade in a Title

In the above example, a Time curve provides the Alpha value to the input socket. The current RenderLayer, which has the title in view, provides the image. As before, the trusty AlphaOver node mixes (using the alpha values) the background swirl and the alphaed title to produce the composite image. Notice the ConvertPre-Multiply button is NOT enabled; this produces a composite where the title lets the background image show through where even the background image is transparent, allowing you to layer images on top of one another.

Using SetAlpha to Colorize a BW Image

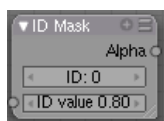


Using Set Alpha to Colorize an Image

In the example above, notice how the blue tinge of the render input colors the swirl. You can use the Set Alpha node's color swatch with this kind of node map to add a consistent color to a BW image.

In the example map to the right, use the Alpha value of the SetAlpha node to give a desired degree of colorization. Thread the input image and the Set Alpha node into an AlphaOver node to colorize any black and white image in this manner. Note the ConvertPre-Multiply button is enabled, which tells the AlphaOver node not to multiply the alpha values of the two images together.

ID Mask Node

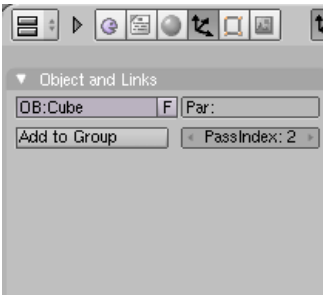


ID Mask node

This node will use the Object Index pass (see RenderLayers) to produce an anti-aliased alpha mask for the object index specified. The mask is opaque where the object is, and transparent where the object isn't. If the object is partially transparent, the alpha mask matches the object's transparency. This post-process function fills in the jaggies with interpolated values.

Object Index

Object indices are only output from a RenderLayers node or stored in a multilayer OpenEXR format image.

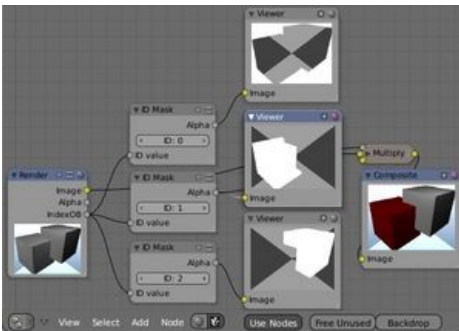


Setting an Object Index

You can specify, for any of the objects in your scene, an Object Index as shown the right (the currently select object has an index of 2). When rendered, if Object Index passes are enabled, its index will be 2, and setting the ID Mask node to 2 will show where that object is in the scene.

This node is extremely well suited to removing the aliases shown as output from the Defocus node or DOF noodles caused by some objects being close to camera against objects far away.

Example

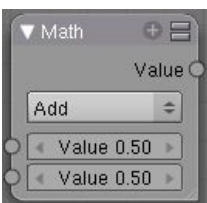


Example

In this example, the left rear red cube is assigned PassIndex 1, and the right cube PassIndex 2. Where the two cubes intersect, there is going to be noticeable pixelation (jaggies) because they come together at a sharp angle and are different colors. Using the mask from object 1, which is smoothed (anti-aliased) at the edges, we use a Mix node set on Multiply to multiply the smoothed edges against the image, thus removing those nasty (Mick) Jaggies. Thus, being smoothed out, the Rolling Stones gather no moss. (I really hope you get that obscure reference :)

Note that the mask returns white where the object is fully visible to the camera(not behind anything else) and black for the part of the object that is partially or totally obscured by a fully or partially opaque object in front of it. If something else is in front of it, even if that thing is partially transparent and you can see the object in a render, the mask will not reflect that partially obscured part.

Math Node



Math node

This node performs the selected math operation on an image or buffer. All common math functions are supported. If only an image is fed to one Value socket, the math function will apply the other Value consistently to every pixel in producing the output Value. Select the math function by clicking the up-down selector where the "Add" selection is shown.

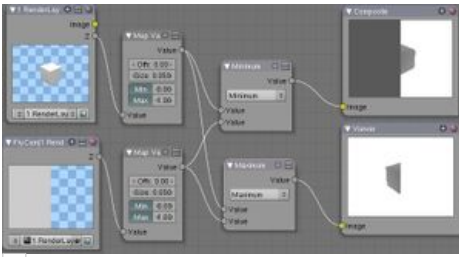
The trig functions of Sine, Cosine, Tangent use only the top socket and accept values in radians between 0 and 2π for one complete cycle.

Known bug: the Top socket must get the image if the bottom socket is left as a value.

Blender 2.44+

Examples

Manual Z-Mask

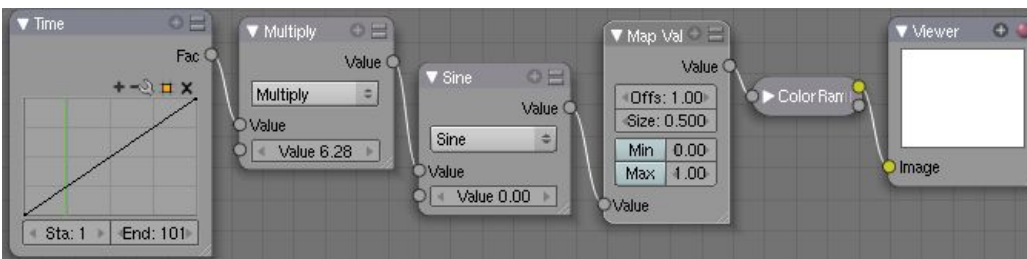


Example

This example has one scene input by the top RenderLayer node, which has a cube that is about 10 BU from the camera. The bottom RenderLayer node inputs a scene (FlyCam) with a plane that covers the left half of the view and is 7 BU from the camera. Both are fed through their respective Map Value nodes to divide the Z buffer by 20 (multiply by .05, as shown in the Size field) and clamped to be a Min/Max of 0.0/1.0 respectively.

For the Minimum function, the node selects those Z values where the corresponding pixel is closer to the camera; so it chooses the Z values for the plane and part of the cube. The background has an infinite Z value, so it is clamped to 1.0 (shown as white). In the maximum example, the Z values of the cube are greater than the plane, so they are chosen for the left side, but the plane (FlyCam) Renderlayer's Z are infinite (mapped to 1.0) for the right side, so they are chosen.

Using Sine Function to Pulsate

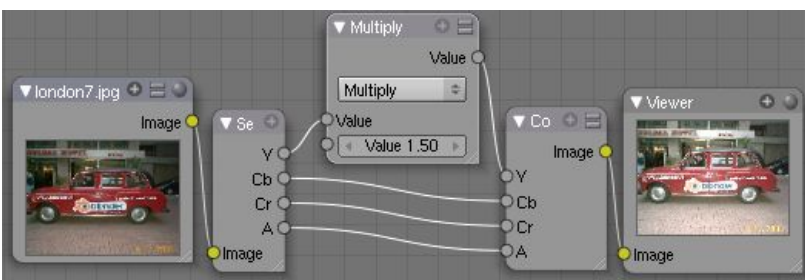


This example has a Time node putting out a linear sequence from 0 to 1 over the course of 101 frames. The green vertical line in the curve widget shows that frame 25 is being put out, or a value of .25. That value is multiplied by 2π and converted to 1.0 by the Sine function, since we all know that $\text{Sine}(2\pi/4) = \text{Sine}(\pi/2) = +1.0$.

Since the Sine function can put out values between -1.0 and 1.0, the Map Value node scales that to 0.0 to 1.0 by taking the input (-1 to 1), adding 1 (making 0 to 2), and multiplying the result by one half (thus scaling the output between 0 and 1). The default ColorRamp converts those values to a grayscale. Thus, medium gray corresponds to a 0.0 output by the sine, black to -1.0, and white to 1.0. As you can see, $\text{Sine}(\pi/2) = 1.0$. Like having your own visual color calculator! Animating this noodle provides a smooth cyclic sequence through the range of grays.

Use this function to vary, for example, the alpha channel of an image to produce a fading in/out effect. Alter the Z channel to move an scene in/out of focus. Alter a color channel value to make a color "pulse".

Brightening/Scaling a Channel



This example has a Multiply node increasing the luminance channel (Y) of the image to make it brighter. Note that you should use a Map Value node with Min() and Max() enabled to clamp the output to valid values. With this approach you could use a logarithmic function to make a high-dynamic range image. For this particular example, there is also a Brighten/Contrast node that might give simpler control over brightness.

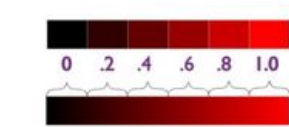
Quantize/Restrict Color Selection

In this example, we want to restrict the color output to only 256 possible values. Possible use of this is to see what the image will look like on an 8-bit cell phone display. To do this, we want to restrict the R, G and B values of any pixel to be one of a certain value, such that when they are combined, will not result in more than 256 possible values. The number of possible values of an output is the number of channel values multiplied by each other, or $Q = R * G * B$.

Since there are 3 channels and 256 values, we have some flexibility how to quantize each channel, since there are a lot of

combinations of R*G*B that would equal 256. For example, if {R,G,B} = {4,4,16}, then $4 * 4 * 16 = 256$. Also, {6,6,7} would give 252 possible values. The difference in appearance between {4,4,16} and {6,6,7} is that the first set {4,4,16} would have fewer shades of red and green, but lots of shades of blue. The set {6,6,7} would have a more even distribution of colors. To get better image quality with fewer color values, give more possible values to the predominant colors in the image.

Theory



Two Approaches to Quantizing to 6 values

To accomplish this quantization of an image to 256 possible values, lets use the set {6,6,7}. To split up a continuous range of values between 0 and 1 (the full Red spectrum) into 6 values, we need to construct an algorithm or function that takes any input value but only puts out 6 possible values, as illustrated by the image to the right. We want to include 0 as true black, with five other colors in between. The approach shown produces {0,.2,.4,.6,.8,1}. Dividing 1.0 by 5 equals .2, which tells us how far apart each quantified value is from the other.

So, to get good even shading, we want to take values that are 0.16 or less and map them to 0.0; values between 0.16 and 0.33 get fixed to 0.2; colorband values between 0.33 and 0.5 get quantized to 0.4, and so on up to values between 0.83 and 1.0 get mapped to 1.0.

Function f(x)

An algebraic function is made up of primitive mathematical operations (add, subtract, multiply, sine, cosine, etc) that operate on an input value to provide a desired output value.

Input		Function				Output	
8-bit	R value	*n	- 1/2	round()	/(n-1)	R value	8-bit
0	0.00	0.00	-0.50	0	0	0	0
13	0.05	0.30	-0.20	0	0	0	0
26	0.10	0.60	0.10	0	0	0	0
38	0.15	0.90	0.40	0	0	0	0
51	0.20	1.20	0.70	1	0.2	0.2	51
64	0.25	1.50	1.00	1	0.2	0.2	51
77	0.30	1.80	1.30	1	0.2	0.2	51
89	0.35	2.10	1.60	2	0.4	0.4	102
102	0.40	2.40	1.90	2	0.4	0.4	102
115	0.45	2.70	2.20	2	0.4	0.4	102
128	0.50	3.00	2.50	2	0.4	0.4	102
140	0.55	3.30	2.80	3	0.6	0.6	153
153	0.60	3.60	3.10	3	0.6	0.6	153
166	0.65	3.90	3.40	3	0.6	0.6	153
179	0.70	4.20	3.70	4	0.8	0.8	204
191	0.75	4.50	4.00	4	0.8	0.8	204
204	0.80	4.80	4.30	4	0.8	0.8	204
217	0.85	5.10	4.60	5	1	1	255
230	0.90	5.40	4.90	5	1	1	255
242	0.95	5.70	5.20	5	1	1	255
255	1.00	6.00	5.50	5	1	1	255

The theory behind this function is scaled truncation. Let us suppose we want a math function that takes in a range of values between 0 and 1, such as .552, but only outputs a value of 0.0, 0.2, 0.4, etc. We can imagine then that we need to get that range 0 to 1 powered up to something 0 to 6 so that we can chop off and make it a whole number. So, with six divisions, how can we do that? The answer is we multiply the range by 6. The output of that first math multiply node is a range of values between 0 and 6. To get even divisions, because we are using the rounding function (see documenation above), we want any number plus or minus around a whole number will get rounded to that number. So, we subtract a half, which shifts everything over. The Round() function then makes that range 0 to 5. We then divide by 5 to get back a range of numbers between 0 and 1 which can then be combined back with the other color channels. Thus, you get the the function

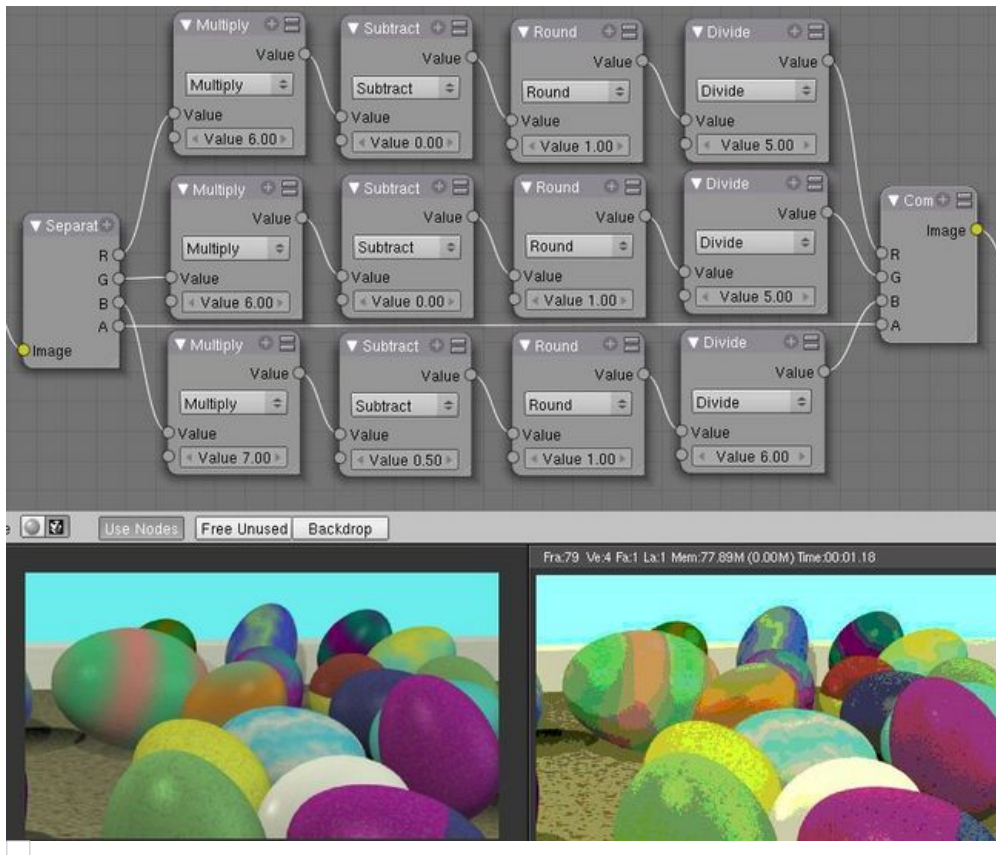
$$f(x,n)=round[x*n-1/2]/(n-1)$$

where n is the number of possible output values, and x is the input pixel color and f(x,n) is the output value. There's only one slight problem, and that is for the value exactly equal to 1, the formula result is 1.2, which is an invalid value. This is because the round function is actually a roundup function, and exactly 5.5 is rounded up to 6. So, by subtracting .501, we compensate and thus 5.499 is rounded to 5. At the other end of the spectrum, pure black, or 0, when .501 subtracted, rounds up to 0 since the Round() function does not return a negative number.

Sometimes using a spreadsheet can help you figure out how to put these nodes together to get the result that you want. Stepping you through the formula for n=6 and x=0.70, locate the line on the spreadsheet that has the 8-bit value 179 and R value 0.7. Multiplying by 6

gives 4.2. Subtracting 1/2 gives 3.7, which rounds up to 4. 4 divided by 5 = .8. Thus, $f(0.7, 6) = 0.8$ or an 8-bit value of 204. You can see that this same 8-bit value is output for a range of input values. Yeah! Geeks Rule! This is how you program Blender to do compositing based on Algebra. Thank a Teacher if you understand this.

Reality



To implement this function in Blender, consider the noodle above. First, feed the image to the Separate RGB node. For the Red channel, we string the math nodes into a function that takes each red color, multiplies (scales) it up by the desired number of divisions (6), offsets it by 0.5, rounds the value to the nearest whole number, and then divides the image pixel color by 5. So, the transformation is $\{0..1\}$ becomes $\{0..6\}$, subtracting centers the medians to $\{-0.5..5.5\}$ and the rounding to the nearest whole number produces $\{0,1,2,3,4,5\}$ since the function rounds down, and then dividing by five results in six values $\{0.0,0.2,0.4,0.6,0.8,1.0\}$.

The result is that the output value can only be one of a certain set of values, stair-stepped because of the rounding function of the math node noodle. Copying this one channel to operate on Green and Blue gives the noodle below. To get the 6:6:7, we set the three multiply nodes to $\{6,6,7\}$ and the divide nodes to $\{5,5,6\}$.

If you make this into a node group, you can easily re-use this setup from project to project. When you do, consider using a math node to drive the different values that you would have to otherwise set manually, just to error-proof your work.

Summary

Normally, an output render consists of 32- or 24-bit color depth, and each pixel can be one of millions of possible colors. This noodle example takes each of the Red, Green and Blue channels and normalizes them to one of a few values. When all three channels are combined back together, each color can only be one of 256 possible values.

While this example uses the Separate/Combine RGB to create distinct colors, other Separate/Combine nodes can be used as well. If using the YUV values, remember that U and V vary between -0.5 and +0.5, so you will have to first add on a half to bring the range between 0 and 1, and then after dividing, subtract a half to bring in back into standard range.

The JPG or PNG image format will store each of the colors according to their image standard for color depth (e.g. JPG is 24-bit), but the image will be very very small, since reducing color depth and quantizing colors is essentially what the JPEG compression algorithm accomplishes.

You do not have to reduce the color depth of each channel evenly. For example, if blue was the dominant color in an image, to preserve image quality, you could reduce Red to 2 values, Green to 4, and let the blue take on $256/(2*4)$ or 32 values. If using the HSV, you could reduce the Saturation and Value to 2 values (0 or 1.0) by Multiply by 2 and Divide by 2, and restrict the Hue to 64 possible values.

You can use this noodle to quantize any channel; alpha, speed (vector), z-values, and so forth.

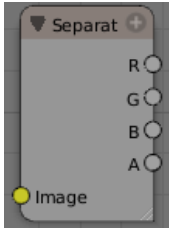
Combine/Separate Nodes

All of these node do essentially the same thing: they split out an image into (or recombine an image from) its composite color channels. Each format supports the Alpha (transparency) channel. The standard way of representing color in an image is called a *color space*. There are several color spaces supported:

- RGB: Red-Green-Blue traditional primary colors, also broadcast directly to most computer monitors
- HSV: Three values, often considered as more intuitive than the RGB system (nearly only used on computers):
 - Hue: the **Hue** of the color (in some way, choose a 'color' of the rainbow);
 - Saturation: the **quantity** of hue in the color (from desaturate - shade of gray - to saturate - brighter colors);
 - Value: the **luminosity** of the color (from 'no light' - black - to 'full light' - 'full' color, or white if Saturation is 0.0).
- YUV: Luminance-Chrominance standard used in broadcasting analog PAL (European) video.
- YCbCr: Luminance-ChannelBlue-ChannelRed Component video for digital broadcast use, whose standards have been updated for HDTV and commonly referred to as the HDMI format for component video.

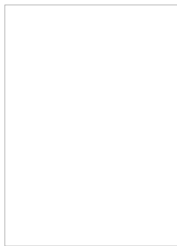
See the global wikipedia for more information on color spaces.

Separate/Combine RGBA Node



Separate
RGBA node

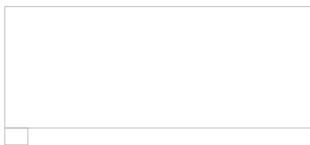
This node separates an image into its red, green, blue and alpha channels. There's a socket for each channel on the right.



Combine
RGBAnode

This node combines separate input images as each color and alpha channel, producing a composite image. You use this node combine the channels after working on each color channel separately.

Examples



In this first example, we take the Alpha channel and blur it, and then combine it back with the colors. When placed in a scene, the edges of it will blend in, instead of having a hard edge. This is almost like anti-aliasing, but in a three-dimensional sense. Use this noodle when adding CG elements to live action to remove any hard edges. Animating this effect over a broader scale will make the object appear to "phase" in and out, as a "out-of-phase" time-traveling sync effect.



In this fun little noodle we make all the reds become green, and all the green both Red and Blue, and remove Blue from the image completely. Very cute. Very fun.

Separate/Combine HSVA Nodes



Separate HSVA node

This node separates an image into image maps for the hue, saturation, value and alpha channels.

Use and manipulate the separated channels for different purposes; i.e. to achieve some compositing/color adjustment result. For example, you could expand the Value channel (by using the multiply node) to make all the colors brighter. You could make an image more relaxed by diminishing (via the divide or map value node) the Saturation channel. You could isolate a specific range of colors (by clipping the Hue channel via the Colorramp node) and change their color (by the Add/Subtract mix node).

Separate/Combine YUVA Node



Separate YUVA node

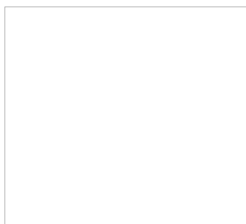
This node converts an RGBA image to YUVA color space, then splits each channel out to its own output so that they can be manipulated independently. Note that U and V values range from -0.5 to +0.5.



Combine YUVA node

Combines the channels back into a composite image. If you do not connect any input socket, you can set a default value for the whole image for that channel using the numeric controls shown.

Separate/Combine YCbCrA Node

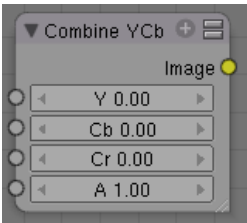


Separate YCbCrA node

This node converts an RGBA image to YCbCrA color space, then splits each channel out to its own output so that they can be manipulated independently:

- Y: Luminance, 0=black, 1=white
- Cb: Chrominance Blue, 0=Blue, 1=Yellow
- Cr: Chrominance Red, 0=Red, 1=Yellow

Note: If running these channels through a ColorRamp to adjust value, use the Cardinal scale for accurate representation. Using the Exponential scale on the luminance channel gives high-contrast effect.



Combine YCbCrA
node

So, I kinda think you get the idea, and I was trying to think of some other creative way to write down the same thing, but I can't. So, you'll have to figure this node out on your own.

Alpha Convert

...

Page status ([reviewing guidelines](#))

Text needs verification that it's up to date with 2.6

Proposed fixes: [X](#)

Composite Matte Nodes

These nodes give you the essential tools for working with blue-screen or green-screen footage, where live action is shot in front of a blue or green backdrop for replacement by a matte painting or virtual background.

In general, hook up these nodes to a viewer, set your UV/Image Editor to show the viewer node, and play with the sliders in real-time using a sample image from the footage, to get the settings right. In some cases, small adjustments can eliminate artifacts or foreground image degradation. For example, taking out too much green can result in foreground actors looking 'flat' or blueish/purplish.

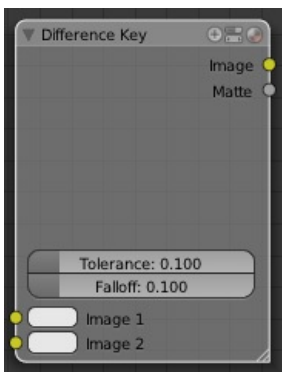
You can and should chain these nodes together, refining your color correction in successive refinements, using each node's strengths to operate on the previous node's output. There is no "one stop shopping" or one "does-it-all" node; they work best in combination.

Usually, green screen is shot in a stage with consistent lighting from shot to shot, so the same settings will work across multiple shots of raw footage. Footage shot outside under varying lighting conditions (and wind blowing the background) will complicate matters and mandate lower falloff values.

Garbage Matte

Garbage matte is not a node, but a technique where the foreground is outlined using a closed curve (bezier or nurbs). Only the area within the curve is processed using these matte nodes; everything else is garbage and thus discarded.

Difference Key Node



Difference Key node

The difference key node determines how different each channel is from the given key in the selected color space. If the differences are below a user defined threshold then the pixel is considered transparent. Difference matting does not rely on a certain background color, but can have less than optimal results if there is a significant amount of background color in the foreground object.

There are two inputs to this node.

- The first is an input Image that is to be keyed.
- The Key Color can be input as an RGB value or selected using the color picker by clicking on the Key Color box to bring up the color dialog, then clicking on the eye dropper tool and selecting a color.

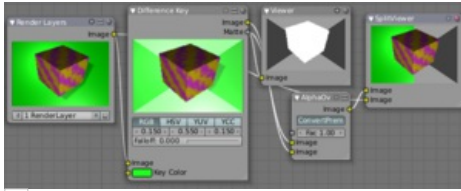
The selectable color spaces are RGB (default), HSV, YUV, and YCbCr.

You can adjust the tolerance of each color in the colorspace individually so that you can have more red variance or blue variance in what you would allow to be transparent. I find that about 0.15 (or 15%) is plenty of variance if the background is evenly lit. Any more unevenness and you risk cutting into the foreground image.

When the Falloff value is high, pixels that are close to the Key Color are more transparent than pixels that are not as close to the Key Color (but still considered close enough to be keyed). When the Falloff value is low, it does not matter how close the pixel color (Image) is to the Key Color, it is transparent.

The outputs of this node are the Image with an alpha channel adjusted for the keyed selection and a black and white Matte (i.e the alpha mask).

Simple Example

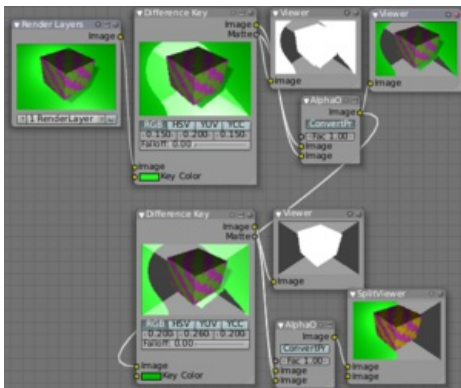


Using the Difference Key Node

In the example to the right (click to expand), we have a purple cube with yellow marbeling in front of a very unevenly lit green screen. We start building our noodle by threading the image to a difference key, and using the eyedropper, pick a key color very close to the edge of the cube, around where the halo is at the corner on the left-hand side; a fairly bright green. We thread two viewers from the output sockets so we can see what (if anything) the node is doing. We add an AlphaOver node, threading the Matte to the **TOP** socket and the image to the **BOTTOM** socket. Very Important, because 0 time blue is not the same as blue times zero. You always want your mask to go to the top socket of the AlphaOver. Premultiply is set and a full multiply is on so that we completely remove the green. In this example, we thread the output of the alphaover to a SplitViewer node so we can compare our results; the original is threaded to the bottom input of the SplitViewer, so that original is on the left, processed is on the right.

We set our variance to .15, and see what we get. What we get (not shown) is a matte that masks around the cube, but not on the right and around the edges where the green is darker; that shade it is too far away from our key color. So, since it is the green that is varying that we want to remove, we increase the Green variation to 1.00 (not shown). Whoa! All the Green disappears (all green within a 100% variation of our green key color is *all* the green), along with the top of the box! Not good. So, we start decreasing the green until we settle on 55% (shown).

Chaining Example

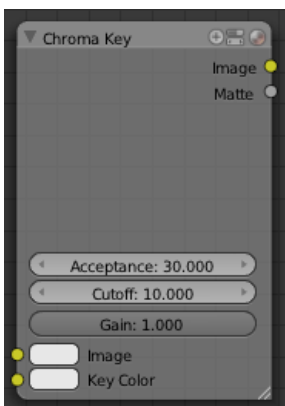


Chaining Difference Key Nodes

We pay out the wazoo for our highly talented (and egotistical I might add) Mr. Cube to come into the studio and do a few takes. We told him NOT to wear a green tie, but when we look at our footage, lo and behold, there he is with a green striped tie on. When we use our simple noodle, the green stripes on his tie go alpha, and the beach background shows through. So, we call him up and, too late, he's on his way back to Santa Monica and it wasn't in his contract and it wasn't his fault, after all, we're supposed to have all this fancy postpro software yada yada and he hangs up. Geez, these actors.

So, we chain two Difference Key nodes as shown to the right, and problem solved. What we did was lower the variation percentage on the first to remove some of the green, then threaded that to a second (lower) difference key, where we sampled the green more toward the shadow side and outside edge. By keeping both variations low, none of the green in his tie is affected; that shade is outside the key's +/- variation tolerances.

Chroma Key Node



Chroma Key node

The Chroma Key node determines if a pixel is foreground or background (and thereby should be transparent) based on its chroma values. This is useful for compositing images that have been shot in front of a green or blue screen.

There is one input to this node, the Image that is to be keyed.

Control this node using:

Green / Blue buttons

Basic selection of what color the background is supposed to be.

Cb Slope and Cr Slope (chroma channel) sliders

Determines how quickly the processed pixel values go from background to foreground, much like falloff.

Cb Pos and Cr Pos sliders

Determines where the processing transition point for foreground and background is in the respective channel.

Threshold

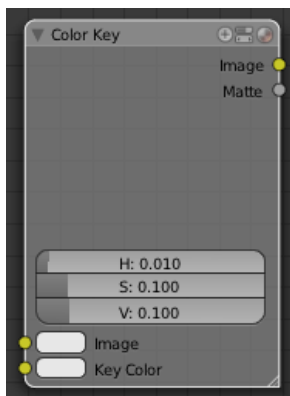
Determines if additional detail is added to the pixel if it is transparent. This is useful for pulling shadows from an image even if they are in the green screen area.

Alpha threshold

The setting that determines the tolerance of pixels that should be considered transparent after they have been processed. A low value means that only pixels that are considered totally transparent will be transparent, a high value means that pixels that are mostly transparent will be considered transparent.

The outputs of this node are the Image with an alpha channel adjusted for the keyed selection and a black and white Matte (i.e the alpha mask).

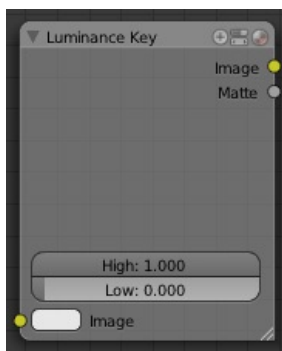
Color Key



Color Key node

The color key node creates a matte based on a specified color of the input image. The sliders represent threshold values for Hue, Saturation, and Value. Higher values in this node's context mean a wider range of colors from the specified will be added to the matte.

Luminance Key Node



Luminance Key node

The Luminance Key node determines background objects from foreground objects by the difference in the luminance (brightness) levels. For example, this is useful when compositing stock footage of explosions (very bright) which are normally shot against a solid, dark background.

There is one input to this node, the Image that is to be keyed.

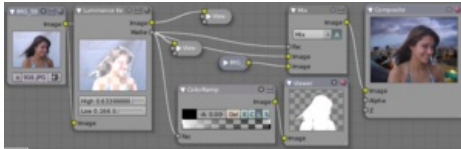
Control this node using:

- The High value selector determines the lowest values that are considered foreground. (which is supposed to be - relatively - light: from this value to 1.0).
- The Low value selector determines the highest values that are considered to be background objects. (which is supposed to be - relatively - dark: from 0.0 to this value).

It is possible to have a separation between the two values to allow for a gradient of transparency between foreground and background objects.

The outputs of this node are the Image with an alpha channel adjusted for the keyed selection and a black and white Matte (i.e the alpha mask).

Example



Using Luma Key...with a twist

For this example, let's throw you a ringer. Here, the model was shot against a *white* background. Using the Luminance Key node, we get a matte out where the background is white, and the model is black; the opposite of what we want. If we wanted to use the matte, we have to switch the white and the black. How to do this? ColorRamp to the rescue - we set the left color White Alpha 1.0, and the right color to be Black Alpha 0.0. Thus, when the Colorramp gets in black, it spits out white, and vice versa. The reversed mask is shown; her white outline is useable as an alpha mask now.

Now to mix, we don't really need the AlphaOver node; we can just use the mask as our Factor input. In this kinda weird case, we can use the matte directly; we just switch the input nodes. As you can see, since the matte is white (1.0) where we don't want to use the model picture, we feed the background photo to the bottom socket (recall the mix node uses the top socket where the factor is 0.0, and the bottom socket where the factor is 1.0). Feeding our original photo into the top socket means it will be used where the Luminance Key node has spit out Black. Voila, our model is teleported from Atlanta to aboard a cruise ship docked in Miami.

Color Spill Node



Color Spill node

The Color Spill node reduces one of the RGB channels so that it is not greater than any of the others. This is common when compositing images that were shot in front of a green or blue screen. In some cases, if the foreground object is reflective, it will show the green or blue color; that color has "spilled" onto the foreground object. If there is light from the side or back, and the foreground actor is wearing white, it is possible to get "spill" green (or blue) light from the background onto the foreground objects, coloring them with a tinge of green or blue. To remove the green (or blue) light, you use this fancy node.

There is one input to this node, the Image to be processed.

The Enhance slider allows you to reduce the selected channel's input to the image greater than the color spill algorithm normally allows. This is useful for exceptionally high amounts of color spill.

The outputs of this node are the image with the corrected channels.

Channel Key Node



Channel Key node

The Channel Key node determines background objects from foreground objects by the difference in the selected channel's levels. For example in YUV color space, this is useful when compositing stock footage of explosions (very bright) which are normally shot against a solid, dark background.

There is one input to this node, the Image that is to be keyed.

Control this node using:

- Color Space buttons selects what color space the channels will represent.
- Channel buttons selects the channel to use to determine the matte.
- High value selector determines the lowest values that are considered foreground. (which is supposed to be - relatively - height values: from this value to 1.0).
- Low value selector determines the highest values that are considered to be background objects. (which is supposed to be - relatively - low values: from 0.0 to this value).

It is possible to have a separation between the two values to allow for a gradient of transparency between foreground and background objects.

The outputs of this node are the Image with an alpha channel adjusted for the keyed selection and a black and white Matte (i.e the alpha mask).

Distance Key

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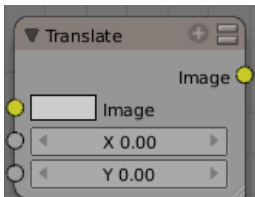
Copy This page is a copy of the same page in 2.4 manual, need to be updated

Proposed fixes: none

Composite Distort Nodes

These nodes distort the image in some fashion, operating either uniformly on the image, or by using a mask to vary the effect over the image.

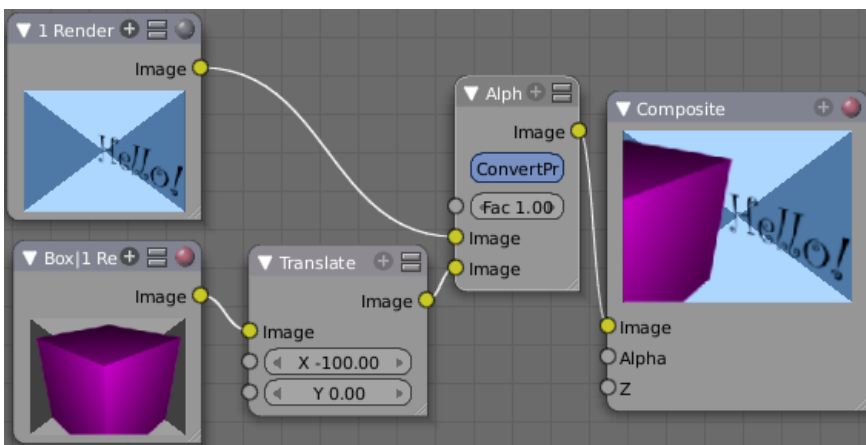
Translate Node



Translate node

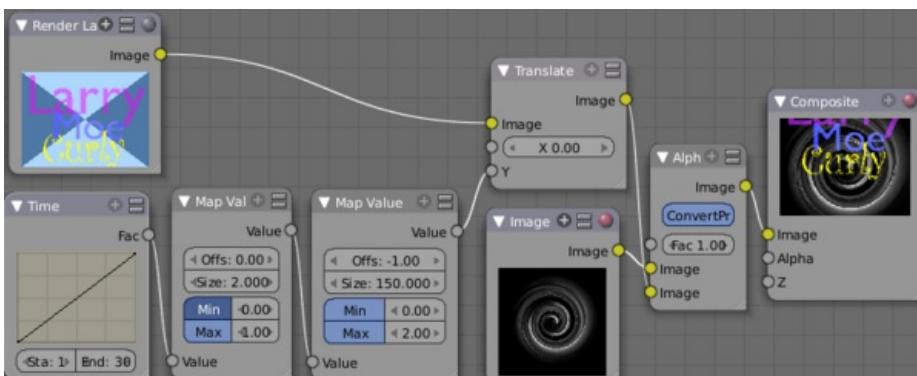
The translate node translates (moves) an image by the specified amounts in the X and Y directions. X and Y are in pixels, and can be positive or negative. To shift an image up and to the left, for example, you would specify a negative X offset and a positive Y.

Use this node to position an image into the final composite image. Usually, the output of this node is routed to an AlphaOver or Mix node to mix it with a base image. In the example below, the RenderLayer input from one scene (box) is translated over to the left (a negative X translation) and alphaovered with a Hello scene RenderLayer input



Example: Using the Translate Node to Roll Credits

At the end of your fantastic animation, you'll want to give credit where credit is due. This is called rolling the credits and you see the names of everyone involved scroll up over a background image or sequence. The mini-map below shows an example of how to roll credits using the Translate node.



Using the Translate Node to Roll Credits

In this node map, the RenderLayer input has a list of the people involved and is 150 pixels high; it is the image input into the Translate

Node. The Y value (vertical) offset of the Translate node comes from a scaled time factor that varies from -150 to 150 over 30 frames. The Translated image is overlaid on top of a background swirl image. So, over the course of 30 frames, the Translate node shifts the image from down by 150 pixels (off the bottom of the screen), up through and overlaid on top of the swirl, and finally off the screen to the top. These frames are generated when the Render Animation buttons are set and Anim is pressed. Right now, frame 21 is showing Moe and Curly, and Larry has scrolled off the screen.

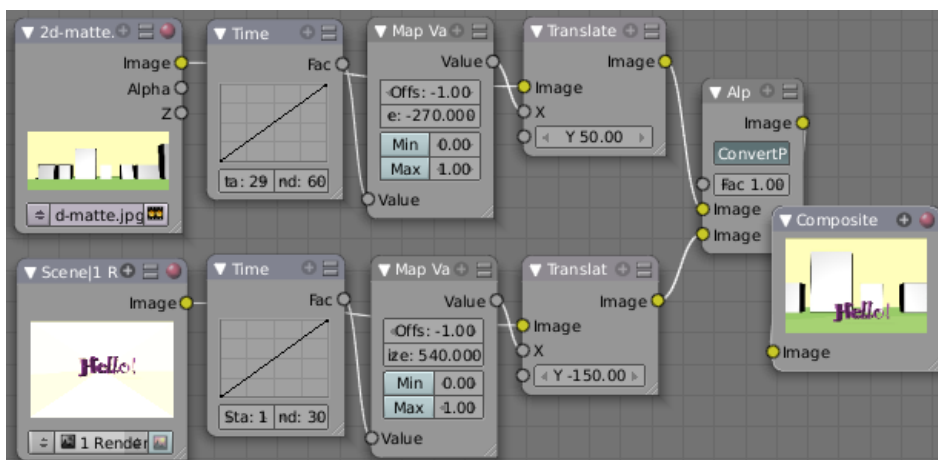
Alpha channel

Be sure to save your credits image in a format that supports an alpha channel, such as PNG, so that the AlphaOver node can overlay it on the background and let the background show through.

You *could* have parented and animated all of the text to roll up past your camera, but rendering would have taken forever. Using the translate node is much faster to composite, and more flexible. To add someone to the list, simply change the credits image and re-animate. Since it is simple image manipulation, Blender is blazingly fast at regenerating your credits. Similarly, changing the background is rock simple as well; simply load up a different background image and re-Animate.

Example: Moving a Matte

In some 2D and 3D animations and movies, a matte painting is used as the background. In most scenes it is still, however you can easily move it using the Translate node. Mattes are huge; the example used below is actually 1440x600 pixels, even though the scene being rendered is for TV. This oversizing gives us room to move the matte around. The example noodle below introduces a dancing "Hello!" from stage right in frames 1-30. As the "Hello!" reaches center stage, we fake a camera move by moving the matte to the left, which makes it look like the "Hello!" is still moving as the camera moves with it.



Moving a Matte in back of a moving Animation (frame 60)

Use the Map Value node to scale the X (left to right) offsets that feed the Translate node. Note that offsets are used to position the dancing "Hello!" down to look like it is walking along the street (in the render scene, it is centered on camera and just dances in place). The matte is adjusted up to fake a camera height of an observer, bringing the horizon up.

Example: Shake, Rattle and Roll

A real world effect is the shaking of the camera. BOOM! We expect to feel the impact and see it rock our world. In our virtual CG world, though, we are in the vacuum of space. So, we have to fake a camera being shook. There are two points in the development cycle to do this: at *Render-Scene* time, and at *Composite* time.

At *Render-Scene* time, the modeler would introduce an lpo curve and keyframes that rotate and/or move the camera for a short amount of time. The advantage to render-scene shake is that the artist handles it and the editor does not have to worry about it; one less thing to do thank goodness. The disadvantage is that the artist may only be modeling the actors, and not the background scenery, props, or matte, so any shake they introduce does not transfer to the set, props, or backdrop. Therefore, it is best to introduce camera shake after all scenes have been rendered and assembled and when they are being composited.

There are two aspects to being bumped, or tripping over the tripod, or having an explosion go off next to you, or an airplane have a near miss as it flies by, or throwing up on a long sea voyage, or surviving an earthquake: *camera motion* and *image blur* (I know you were thinking expletives and changing your underpants, but this is about compositing).

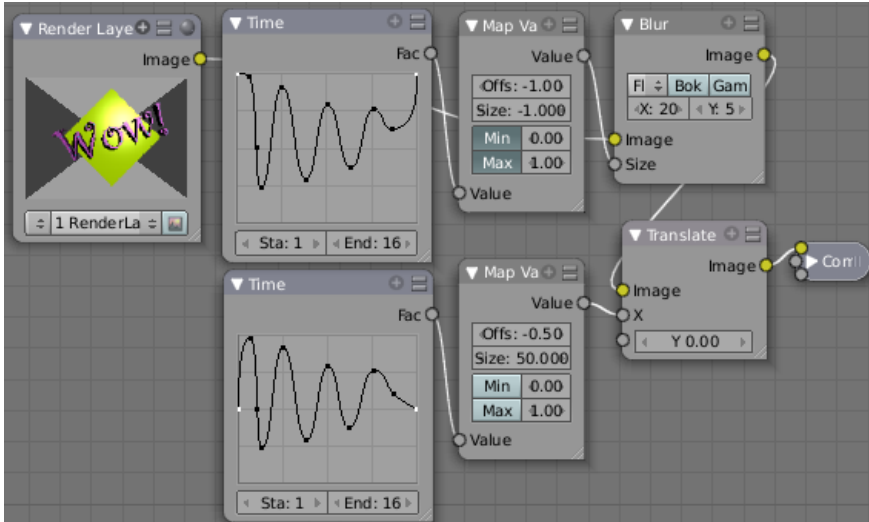
Camera Motion happens because the camera physically gets moved; but its mass and its tripod also acts as a dampening device, softening out and absorbing the initial bump. The cameraman also acts as a dampener, and also as a corrector, trying to get the camera back to where it was pointed originally.

There can be quite a delay between the shock and the correction; for example, a lone actor/cameraman may trip on the tripod coming out from behind the camera, come into frame, realize the camera is off, and then come back to correct it. It all depends on the artistic effect and story you want to convey.

The *image blur* comes into play because the shake happens so rapidly that the image is blurred in the direction of the shake. However, the blur is more when the camera is being pushed back into position, and less when the camera is at the extreme of its deflection, since it is decelerating at the apex of its movement. Like motion, blur is the most during the initial shock, and less as things

slow down and get under control. Also, the camera may go out of focus and come back into focus at the end of the shake.

To use Blender nodes to mimic Camera Motion, use the noodle shown below. The noodle has a Blur group on top that feeds a Translate group below it.



SFX: Camera Shake

In the above example, we use a Time curve that mimics the intensity and duration of a typical BOOM!. In this case, both curves have four peaks within a 16-frame period to mimic a BOOM! (in fact one curve was constructed and then duplicated to make the other, to ensure that the bulk of both curves was exactly the same). Notice how the curve dampens (decreases in magnitude as time progresses) as discussed above. Notice how the curve slows down (increasing period) to mimic the cameraman getting it back under control. Notice that the curve is sinusoidal to mimic over-correction and vibration.

BOOM! to the Left: The translate curve starts at 0.5. Maximum deflection up is fully a half, yet down is only a quarter. This offset mimics a BOOM! off to our left, since the camera shakes more to the right, away from the BOOM!

Motion and Blur are the same but different: Notice that the two curves are identical except for the highlighted start and end dots; we want zero blur and zero offsets before and after the shake, but minimum blur when there is maximum translate. The two Map Value node settings are different to achieve this; the math is left to the reader.

Use this Blender noodle to mimic camera shake. The amount of shake is set by the Size values, and the blur should be proportional to the amount and direction of motion (predominantly X in this example). Use the Time start and end to vary the duration of the shake; ten seconds for an earthquake, one minute for a ship rolling in the seas, a half second as an F-14 flies by and takes your ear off. *Author's note: I noticed cool camera shakes while watching the Halo 3 previews.*

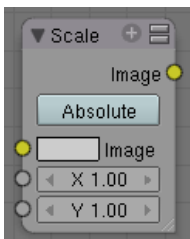
Rotate Node



Rotate node

This node rotates an image. Positive values rotate clockwise and negative ones counterclockwise.

Scale Node



Scale node

This node scales the size of an image. Scaling can be either absolute or relative. If Absolute toggle is on, you can define the size of an image by using real pixel values. In relative mode percents are used.

For instance X: 0.50 and Y: 0.50 would produce image which width and height would be half of what they used to be. When expanding an image greatly, you might want to blur it somewhat to remove the square corners that might result. Unless of course you want that

effect; in which case, ignore what I just said.

Use this node to match image sizes. Most nodes produce an image that is the same size as the image input into their top image socket. So, if you want to uniformly combine two images of different size, you must scale the second to match the resolution of the first.

Flip Node



Flip node

This node flips an image at defined axis that can be either X or Y. Also flipping can be done on both X and Y axis' simultaneously.

You can use this node to just flip or use it as a part of mirror setting. Mix half of the image to be mirrored with its flipped version to produce mirrored image.

Displace Node

Ever look down the road on a hot summer day? See how the image is distorted by the hot air? That's because the light is being bent by the air; the air itself is acting like a lens. This fancy little node does the same thing; it moves an input image's pixels based on an input vector mask (the vector mask mimics the effect of the hot air).

This can be useful for a lot of things, like hot air distortion, quick-and-dirty refraction, compositing live footage behind refracting objects like looking through bent glass or glass blocks, and more! Remember what HAL saw in 2001:Space Odyssey; that distorted wide-angle lens? Yup, this node can take a flat image and apply a mask to produce that image.

The amount of displacement in the X and Y directions is determined by

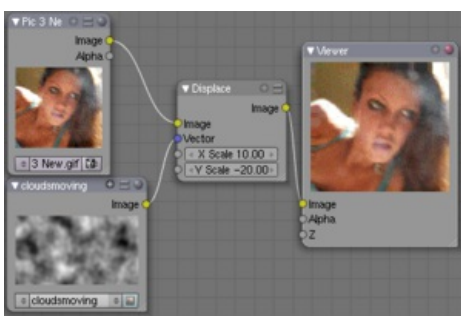
- The value of the mask's channels:
- The scaling of the mask's channels

The (red) channel 1's value determines displacement along the positive or negative X axis. The (green) channel 2's value determines displacement along the positive or negative Y axis.

If both the channels' values are equal (i.e. a greyscale image), the input image will be displaced equally in both X and Y directions, and also according to the X scale and Y scale buttons. These scale buttons act as multipliers to increase or decrease the strength of the displacement along their respective axes. They need to be set to non-zero values for the node to have any effect.

Because of this, you can use the displace node in two ways, with a greyscale mask (easy to paint, or take from a procedural texture), or with a vector channel or RGB image, such as a normal pass, which will displace the pixels based on the normal direction.

Example



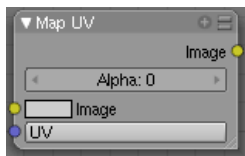
Music Video Distortion Example Using Displace

In this example, she's singing about dreams of the future. So, to represent this, we use a moving clouds texture (shot just by rendering the cloud texture on a moving plane) as the displacement map. Now, the colors in a black and white image go from zero (black) to one (white), which, if fed directly without scaling would only shift the pixels one position. So, we scale their effect in the X and Y direction.

Upon reviewing it, sometimes stretching in both the X and Y direction made her face look fat, and we all can guess her reaction to looking fat on camera. SO, we scale it only half as much in the X so her face looks longer and thinner. Now, a single image does not do justice to the animation effect as the cloud moves, and this simple noodle does not reflect using blur and overlays to enhance (and complicate) the effect, but this is the core.

Photos courtesy of Becca, no rights reserved. See also some movies of this node in action, made by the wizard programmer himself, by following this [external link](#)

Map UV Node



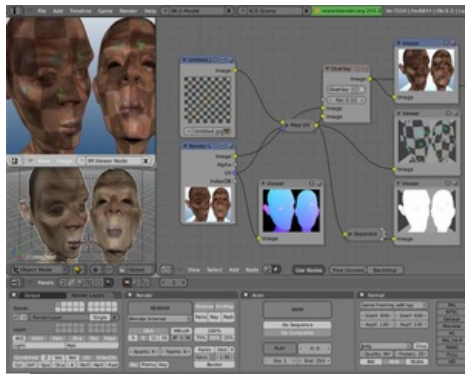
So, I think we all agree that the problem is...we just don't know what we want. The same is true for directors. Despite our best job texturing our models, in post production, inevitably the director changes their mind. "Man, I really wish he looked more ragged. Who did makeup, anyway?" comes the remark. While you can do quite a bit of coloring in post production, there are limits. Well, now this little node comes along and you have the power to **re-texture your objects after they have been rendered**. Yes, you read that right; it's not a typo and I'm not crazy. At least, not today.

Using this node (and having saved the UV map in a multilayer OpenEXR format image sequence), you can apply new flat image textures to all objects (or individual objects if you used the very cool [ID Mask Node](#) to enumerate your objects) in the scene.

Thread the new UV Texture to the Image socket, and the UV Map from the rendered scene to the UV input socket. The resulting image is the input image texture distorted to match the UV coordinates. That image can then be overlay mixed with the original image to paint the texture on top of the original. Adjust alpha and the mix factor to control how much the new texture overlays the old.

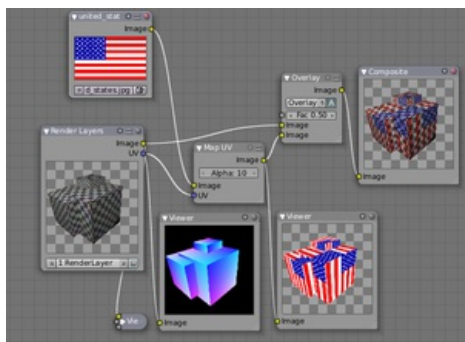
Of course, when painting the new texture, it helps to have the UV maps for the original objects in the scene, so keep those UV texture outlines around even after all shooting is done.

Examples



Adding a Grid UV Textures for Motion Tracking

In the example to the right, we have overlaid a grid pattern on top of the two Emo heads after they have been rendered. During rendering, we enabled the UV layer in the RenderLayer tab (Buttons window, Render Context, RenderLayer tab). Using a mix node, we mix that new UV Texture over the original face. We can use this grid texture to help in any motion tracking that we need to do.



Adding UV Textures in Post-Production

In this example, we overlay a flag on top of a cubie-type thing, and we ensure that we Enable the Alpha pre-multiply button on the Mix node. The flag is used as additional UV Texture on top of the grid. Other examples include the possibility that we used an unauthorized product box during our initial animation, and we need to substitute in a different product sponsor after rendering.

Of course, this node does NOT give directors the power to rush pre-production rendering under the guise of "we'll fix it later", so maybe you don't want to tell them about this node. Let's keep it to ourselves for now.

Crop Node

The Crop Node takes an input image and crops it to a selected region.

Crop Image Size

When enabled, the image size is cropped to the specified region. When disabled, image remains the same size, and uncropped areas become transparent pixels.

Relative

When enabled, crop dimensions are a percentage of the image's width and height. When disabled, the range of the sliders are the width and height of the image in pixels.

Crop Region Values

These sliders define the lower, upper, left, and right borders of the crop region.

Lens Distortion

Use this node to simulate distortions that real camera lenses produce.

Distort

This creates a bulging or pinching effect from the center of the image.

Dispersion

This simulates chromatic aberration, where different wavelengths of light refract slightly differently, creating a rainbow colored fringe.

Projector

Enable or disable slider projection mode. When on, distortion is only applied horizontally. Disables Jitter and Fit.

Jitter

Adds jitter to the distortion. Faster, but noisier.

Fit

Scales image so black areas are not visible. Only works for positive distortion.

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Proposed fixes: none

Sequence Editing

In addition to modeling and animation, Blender has a fully functional Video Sequence Editor (VSE) as well as an advanced node-based editor that also manipulates a video stream. [Compositing Nodes](#) operate equally well on images or video streams, and can apply detailed image manipulation on the stream.

Operating at a higher conceptual level, and used later in the video production process, Blender's legacy VSE operates on a set of entire strips at a time, as a chunk of footage. The many parts of Blender work together in typical work flow fashion:

- Model to construct the objects
- Assign Materials and introduce Lighting to color the objects
- Animate your objects to make them move
- Render layers of video using cameras
- Use Compositing nodes to:
 - Enhance the images by adjusting colors, adding in-scene special effects
 - Layer the images into a composite image sequence (strip)
- Assemble the video strips together to make a movie using the VSE.

The VSE within Blender is a complete video editing system that allows you to combine multiple video channels and add effects to them. Its functionality has been inside Blender since the beginning. Even though it has a limited number of operations, you can use these to create powerful video edits (especially when you combine it with the animation power of Blender!) Furthermore, it is extensible via a plugin system to perform an unlimited number of image manipulations.

Using the VSE, you load multiple video clips and lay them end-to-end (or in some cases, overlay them), inserting fades and transitions to link the end of one clip to the beginning of another. Finally, add an audio track so you can synchronize the timing of the video sequence to match it. The result of using the VSE is your finished movie.

FFMPEG Support

Support for exporting an avi/quicktime movie using FFMPEG does work, currently (since 2.44) only within the Linux and Windows builds. With FFMPEG support, you are able to save the audio track with your video.

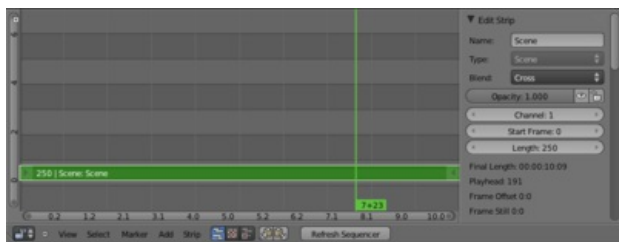
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Proposed fixes: none

Overview of the Sequence Editor

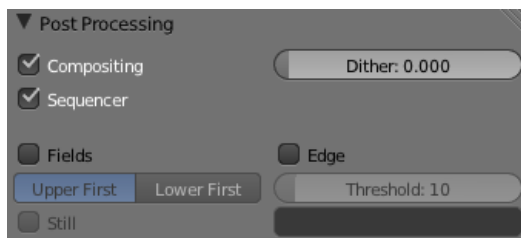
Blender's Video Sequence Editor is a flexible workbench for editing your video footage. It is used to review your footage, and glue many sequences of your movie together. It offers a number of built-in and plug-in effects to transition from sequence to sequence, providing advanced hollywood-style effects for a professional looking video.



Video Sequence Editor in Sequence display mode

The Video Sequence Editor has a header (where the menu and view modes are shown) and a workspace, and works in one of several view modes. The Marker menu allows you to add markers in the VSE. Markers are shared across animation editors. See [Markers](#)

The sequencer workspace is horizontally striped into channels and each video strip will go in a horizontal channel. Each channel is numbered on the left-hand side, starting from 0 (you can't put anything thing in this special one!) and going up. Stripes toward the bottom are more dominant, which we'll get to in a minute. In the x direction, seconds of animation or frames of animation (Ctrl/T to choose) are used as the measure of time (seconds 1 through 7 are shown). You can scale the time using the zoom keys or mouse actions (see the Reference for more info).



Sequence Output Enabled

When you click Render or Anim to generate an image or video, Blender has a choice of what image to compose for the current frame/scrub range:

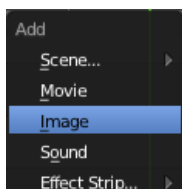
- Current Scene layer result
- Sequence Editor channel 0 result
- Composition Node Editor renderlayer result

The video sequencer is enabled by default.

When you go to the render panel where ordinary renderings take place and you click animation or image with the VSE open, it will render the clips for the VSE instead of the scene.

Using the Sequence Editor

Adding Strips



the add menu

The Add menu is the main menu you will be using to add content to the VSE. In general, you load up your strips, create strips of special transition effects, and then animate out your sequence by selecting "Do Sequence" and clicking the Anim button. You can use the Add menu in the header, or hover your mouse cursor over the Sequence workspace and press ⇧ ShiftA.

Clips can be Huge

A three minute quicktime .mov file can be 140Megs. Loading it, even over a high-speed LAN can take some time. Don't assume your computer or Blender has locked up if nothing happens for awhile.

First, let's add a clip:


- A movie clip in the Audio-Video Interleaved format (*.avi file)
- A movie clip in the Apple QuickTime format (*.mov)
- A single still image to be repeated for a number of frames (*.jpg, *.png, etc.)
- A numbered sequence of images (*-0001.jpg, *-0002.jpg, *-0003.jpg, etc, of any image format)
- One or more images from a directory
- A Scene in your .blend file.


Blender does not care which of these you use; you can freely mix and match any of them. They all become a color-coded strip in the VSE:

- Blue is used for Avi/mov codec strips
- Grey is a single image that is repeated/copied
- Purple is an image sequences or group of images played one after the other
- Green is an Audio track

When you choose to add one of these, the VSE window will switch to a file browser for you to select what you want to add. Supported files have a little rectangle next to their name (blue for images, green for clips) as a visual cue that you can pick them successfully:

Add Movies or Images

When adding a Movie or Movie+Audio LMB  LEFT CLICK to put the name of the file into the text box at the top; this selects a **single** file (like a movie)




In the case of (numbered) image **sequences**, you have a choice: **Directory**: RMB  right-click on a directory name, and all files in that directory will be brought in as part of the image, in sort order, one image per frame **Range**: Navigate into the directory and right-click and drag over a range of names to highlight multiple files. You can page down and continue right-click-dragging to add more to the selection **Batch**: Shift-right-click selected non-related stills for batch processing; each image will be one frame, in sort order, and can be a mix of file types (jpg, png, exr, etc.) **All**: Press A to select/deselect All files in the directory.

When you click the Select <whatever> button, the window pane will switch back to VSE, and the strip will be rubber-banded to your mouse. You cannot load multiple movies at the same time by right-clicking them; no movies load if you right click them. Right-clicking only works for images.

Error: The selected file is not a movie or FFMPEG support not compiled in!

means that the file is not a movie that Blender can recognize, or **you selected with the wrong button**. You get this error message because you *right*-clicked on a movie file, OR you don't have a codec that can decode the avi file. If it's the latter, find a codec so you can play the file outside of Blender, and then you will be able to load it. If it's the former, you must left-click to select movies.

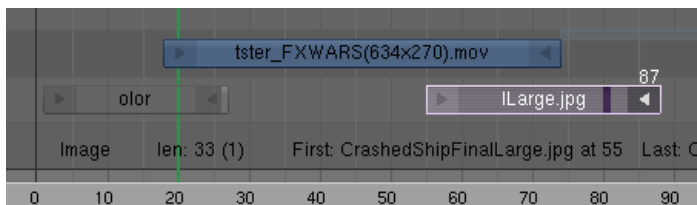
In order to add items to the VSE, left-click for movies, left-click for single images, or right-click and drag for image sequences. Move your mouse to the frame/time and stripe you want, and click to break the rubberband and drop the strip in place (in a channel and starting at a frame).

When you add an image, Blender makes it into a 50-frame strip, which means that image will be in your video for two seconds (at 25 fps – PAL). Aside from re-positioning it, you will want to scale it by RMB -clicking on either the start or end arrow, and dragging left or right. As you move, the frame number updates to say where the arrow is. Click LMB  to validate, or RMB  to cancel the modification.



Dealing with Different Sizes

Dealing with different sized images and different sized outputs is tricky. Think like a pixel. If you have a mis-match between the size of the input image and the render output size, the VSE does try to auto-scale the image to fit it entirely in the output. This may result in clipping. If you do not want that, use Crop and/or Offset in the Input panel to move and select a region of the image within the output. When you use Crop or Offset, the auto-scaling will be disabled and you can manually re-scale by adding the Transform effect.



If you scroll up the workspace, you will see an information channel (at vertical location channel 0) that gives you some helpful hints about the active strip. The example above shows a color strip from frames 1 to 25, then a mov file, and then an image strip. The info channel shows handy information about the image strip, whose name has been scrunched in the strip display, but is clearly spelled out in the information strip.

9999 frames go by (IMAGE strips only!)

Ok, so that was a very obscure reference to a song about 99 balloons, but we really have not anticipated how fast Blender has moved into mainstream video editing. Unfortunately, we initially reserved 4 digits for the filename of each video image sequence set. While that provides for up to 400 seconds of video (about 5 minutes US), with Blender moving into movies, you need to break up IMAGE strips into 4 digits only, and others 5 digits (10000-19999), (20000-29999), etc. Important: that only affects IMAGE strips at the moment. All the other strip types work fine with up to 300,000 frames (approximately 3 hours, read: Ben Hur :).

Codecs

You must have a codec on your machine that can decode the avi file. Blender does not control these. For example, the XviD codec is available from www.xvid.org

FFMPEG Support

If you are using a Blender build with FFMPEG support, you will be able to load audio and video strips together; select Movie+Audio(HD) and when you drop the strip, the strip will split into an audio and video channel strips.

Add Scene

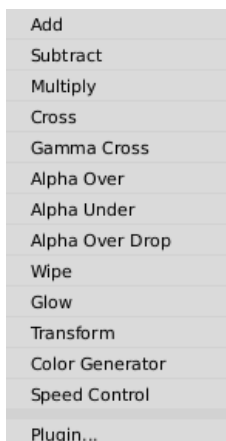
You can add the virtual image output of a Scene in your current .blend file as well. Select the scene from the popup list, and a strip will be added and rubberbanded to your mouse just like a movie or image. The strip length will be determined based on the animation settings in that scene (not the current scene, unless the VSE is operating in the same scene).

When adding a Scene strip, please note that, in order to show you the strip in the VSE Image preview mode, Blender must render the scene. This may take awhile if the scene is complex, so there may be a delay between the time you select the scene and the time the strip appears. To reduce the delay, simplify the scene rendering by selecting fewer layers to render.

Add Audio

The VSE can incorporate an audio channel which you can hear as you scrub. Add an audio track when you are trying to time your video/animation to an audio track, or vice versa. Please refer to [the Audio Sequences section](#) for more information.

Adding Effects



Available Built-in Effects

Blender offers two categories of effects: Built-in and Plug-in. The built-in effects are listed to the right. They are built-in to Blender and everyone has them. The plug-in effects are separate files in a sequence-plugin directory on your PC that are loaded as they are needed. While a standard set of plugins are distributed when you installed Blender, everyone's computer may have a different set.

Every Built-in effect is explained in the next page individually, but they all are added and controlled in the same way. To add an effect strip, select one base strip (image, movie, or scene) by RMB clicking on it. For some effects, like the Cross transition effect, you will need to **⇧ Shift RMB** a second overlapping strip (it depends on the effect you want). Then select Add -> Effect and pick the effect you want from the pop-up menu. When you do, the Effect strip will be shown above the source strips. If it is an independent effect, like

the color generator (described later), it will be rubberbanded to your mouse; click to drop the strip.

Since most Effects strips depend on one or two source strips, their frame location and duration depends on their source strips. Thus, you may not be able to move it; you have to move the source strips in order to affect the effect strip.

To use an effect that combines or makes a transition between (or composites) two strips, you must Box select or shift-right-click two of them. When you add the effect strip, it will be placed in a channel above the two in Grab mode (click to drop it on a channel). Its duration will be the overlap between the two strips as a maximum.


With some effects, like the AlphaOver, the order in which you select the strips is important. You can also use one effect strip as the input or source strip with another strip, thus layering effects on top of one another.

Note: The only exception is the Color Generator effect. It does not depend on a base strip; you can add and position it independent of any other strip. Change the length as you would any strip.

Mode: Sequence, Effects Strip Selected

Hotkey: C

Menu: Strip -> Change Effect

If you picked the wrong effect from the menu, you can always change it by selecting the strip (RMB ) and using the Strip->Change Effect selection. Or, you can press Change to switch effects on a selected Effects strip.

Adding Plugin Effects



Strip Properties

The properties for the strip are examined and set in the properties panel, shortcut N.

- Edit - change properties of the strip
- Input - where to pull images from
- Effect - Settings for effects strips
- Filter - Image pre-processing
- Proxy - Use representatives of the real image, for low-powered PCs
- Scene - Settings for when a scene strip is selected
- Sound - Settings for a sound clip

The panels for each of these sets of options and controls are shown to the right

Edit Strip Panel

Name

You can name or rename your strips here.

Type

Displays the type of strip selected.

Blend Mode

By default, a strip Replaces the output image of any lower-level strips. However, many other blending modes are available based on the strip type. For example, Alpha-Over automatically overlays the image on top of a lower level strip. These autoblending modes obviates the need for separate effect strips. Blend percent controls how much of an (even over time) effect the strip exerts.

Opacity

Set the opacity of the strip.

Mute

Hides the strip so that it does not participate in the final image computation

Lock

Prevents the strip from being moved.

Channel

Changes the channel number, or row, of the strip.

Start Frame

Changes the starting frame number of the strip, which is the same as grabbing and moving the strip. Tip: when you add a strip, I like to just drop it and then use this field to place it at the frame I want, rather than trying to drag and drop in exactly the right place.

Length

Specify the number of frames to use for the strip.

Use the Convert to Premul button if a strip has an Alpha (transparency) channel. Use FilterY if the strip is from broadcast video and has even or odd interlacing fields. Enhance the color saturation through the Multiply field. Play a strip backwards by enabling Reverse Frames. Tell Blender to display every nth frame by entering a Strobe value. Finally, when using MPEG video (VCD, DVD, XVID, DivX, ...), an image is built up over the course of a few frames; use the Preseek field to tell Blender to look backward and compose the image based on the n previous frames (e.g. **15** for Mpeg2 DVD).

Effect Strip

For all effects, use the Strip Properties panel to control the effects strip; each effect has different controls, but they can all be set in the Properties panel. Control the length of the strip to vary the speed with which the transform happens. Regardless of whether they are built-in or plug-in, all effect strips do some special image manipulation, usually by operating on another strip or two in a different channel. The effect strip is shown in some channel, but its resultant effect shows up as Channel 0.

Strip Input

Controls the source of the strip. Fields include file path, file name, image offset, crop settings.

This is here you can edit/update the path of the file used by a strip. Very useful when you moved it one way or the other – this avoid you deleting and re-creating the strip!

You have two text fields for path, the first being the path of the parent directory (Path), and the second the file name itself.

Filter

Enables you to quickly set common image pre-processing options.

Strobe

Flip

X flips (reverses) the image left-to-right, Y reverses top-to-bottom.

Backwards

Reverses strip image sequence

De-Interlace

Removes fields in a video file.

Saturation

Increase or decrease the saturation of an image.

Multiply

Multiplies the colors by this value.

Premultiply

Premultiply the Alpha channel.

Convert Float

Converts input to float data.

Use Color Balance

Provides three filters to adjust coloration: Lift, Gamma, and Gain. Each pass can have a positive, or inverted effect by clicking the appropriate button. Set the amount of the effect by setting the color swatch; white (RGB 1,1,1) has no effect.

Proxy Strip Properties Panel

A proxy is a smaller image (faster to load) that stands in for the main image. When you Rebuild proxy Blender computes small images (like thumbnails) for the big images and may take some time. After computing them, though, editing functions like scrubbing and scrolling and compositing functions like cross using these proxies is much faster but gives a low-res result. Disable proxies before final rendering.

Sound

This panel appears when a sound file is selected.

Here you can specify the Sound Strip's file path and file name.

Pack

Packs the sound file into the current .blend file.

Caching

The sound file is decoded and loaded into RAM.

Volume

Set the volume of the Sound file.

Attenuation/dB

Attenuation in decibels

Trim Duration: Start/End

Offset the start and end of a sound strip.

Scene

Specify the scene to be linked to the current scene strip.

Sequencer

Process the render (and composited) result through the video sequence editor pipeline, if sequencer strips exist. This is the same function as in the render settings.

Camera Override

Change the camera that will be used.

Adjusting the View

Use these shortcuts to adjust the sequence area of the VSE:

Pan MMB 

Zoom Wheel 

Vertical Scroll use ⇧ Shift Wheel , or drag on the left scroll bar.

Horizontal Scroll use Ctrl Wheel , or drag on the lower scroll bar.

Scale View Vertically, drag on the circles on the vertical scroll bar.

Scale View Horizontally, drag on the circles on the horizontal scroll bar.

As usual, the View Menu controls what and how you view in the workspace.

Properties Panel

The Properties Panel contains options for the way the preview is displayed.

View all Sequences ⌘ Home

Zooms (out) the display to show all strips.

Fit preview in Window ⌘ Home

Resizes preview so that it fits in the window.

Show Preview 1:1 1 NumPad

Resizes preview to a 1:1 scale (actual size).

View Selected . NumPad

Zooms in the display to fit only the selected strips

Use this when working arranging a lot of strips and you want to use all of your screen to work.

Mode: Sequence

Hotkey: T

Menu: View -> Show Frames, View -> Show Seconds

Draw Frames

Displays the frame number instead of the time, in the Frame Number Indicator.

Show Frame Number Indicator

Toggles the units of measure across the bottom of the workspace between seconds or frames.

Safe Margin

Displays an overlay on the preview, marking where title safe region is.


Separate Colors

When using Luma Waveform view, this separates R,G, and B into separate graphs.

Transform Markers

Transform Markers as well as Strips.

Scrubbing

To move back and forth through your movie, use the Timeline window. LMB  click and drag left/right in the timeline window, moving the vertical bar which indicates the current frame. As you do, the image for that frame is displayed in the VSE window.

Real-time scrubbing and image display is possible on reasonable computers when viewing an image sequence or movie (avi/mov) file. Scene images have to be rendered individually, which may take some time.

View Modes

The icons in the header allow to change the view of the VSE. By default, only the sequencer is displayed. The second button displays only the Preview window, and the third button displays both the Sequencer and the Preview.

When the preview is enabled, you have several options to change what type of preview to display. They are explained in the [Display Modes Page](#).

Scene Preview

When using a Scene Strip in the sequencer, these settings in the Properties Panel determine how they are shown in the preview window.

Open GL Preview

If you have Open GL, enable this setting to use Open GL for the scene preview renders.

The drop down menu allows you to change how the Scene is displayed (Bounding Box, Wireframe, Solid, Textured).

View Settings

The View Settings section in the properties panel contains additional display options.

Show Overexposed

Increasing this number to 1 or greater displays a striped overlay to the preview image, showing where it is overexposed. A higher number gives a higher threshold for marking overexposure.

Safe Margin

Displays an overlay on the preview, marking where the title safe region is.

Proxy Render Size

Draws preview using full resolution or different proxy resolutions. Render resolution is determined in the render settings panel. Using a smaller preview size will increase speed.

Refresh View

Certain operations, like moving an object in 3D View, may not force the Sequencer to call for a refresh of the rendered image (since the movement may not affect the rendered image). If an image or video, used as a strip, is changed by some application outside of Blender, Blender has no real way of being notified from your operating system. To force Blender to re-read in files, and to force a re-render of the 3D View, click the Refresh button to force Blender to update and synchronize all cached images and compute the current frame.

Selecting Strips

The Select Menu helps you select strips in different ways.

Strips to the Left

Select all strips to the left of the currently selected strip.

Strips to the Right

Select all strips to the right of the currently selected strip.

Select Surrounding Handles Alt+Ctrl RMB

Select both handles of the strip, plus the neighboring handles on the immediately adjoining strips. Select with this method to move a strip that is between others without affecting the selected strip's length.

Left Handle Alt RMB

Select the left handle of the currently selected strip.

Right Handle Ctrl RMB

Select the right handle of the currently selected strip.

Linked

Select all strips linked to the currently selected strip

Select All A

Selects all the strips loaded.

Select Inverse

Inverts the current selection.

Border Select B


Begins the Box mode select process. Click and drag a rectangular lasso around a region of strips in your Sequence workspace. When you release the mouse button, the additional strips will be selected.

Moving and Modifying Strips

G Moves the selected strip(s) in time or in channels. Move your mouse horizontally (left/right) to change the strip's position in time. Move vertically (up/down) to change channels.

- To snap while dragging hold Ctrl
- To 'ripple edit' (Make room for strips you drag) hold Alt when placing a strip.

If you have added a strip by mistake or no longer want it, delete it by pressing X or using this menu option.

Duplicate a strip to make an unlinked copy; drag it to a time and channel, and drop it by LMB  click.

The Strip Menu contains additional tools for working with strips:

Grab/Move

Grab/Extend from Frame

Cut (hard) at frame

Cut (soft) at frame

Separate Images

Deinterlace Movies

Duplicate Strips
Erase Strips
Set Render Size
Make Meta Strip
UnMeta Strip
Reload Strips
Reassign Inputs
Swap Inputs

Lock Strips
UnLock Strips
Mute Strips
Un-Mute Strips
Mute Deselected Strips
Snap Strips
Swap Strips




Snap to Frame

⇧ Shift S Position your cursor (vertical green line) to the time you want. Snap to current frame to start a strip exactly at the beginning of the frame. If your Time display is in seconds, you can get to fractional parts of a second by zooming the display; you can get all the way down to an individual frame.


Separate Images to Strips

Y Converts the strip into multiple strips, one strip for each frame. Very useful for slide shows and other cases where you want to bring in a set on non-continuous images.

Editing Strips

- RMB  in the middle of the strip selects the **entire** strip; holding it down (or pressing Grab) and then moving the mouse drags a strip around.
- RMB  on the left arrow of the strip selects the **start** frame offset for that strip; holding it down (or pressing Grab) and then moving the mouse left/right changes the start frame within the strip by the number of frames you move it:
 - If you have a 20-image sequence strip, and drag the left arrow to the right by 10 frames, the strip will start at image 11 (images 1 to 10 will be skipped). Use this to clip off a rollout or useless lead-in.
 - Dragging the left arrow left will create a lead-in (copies) of the first frame for as many frames as you drag it. Use this when you want some frames for transitions to the this clip.
- RMB  on the right arrow of the strip selects the **end** frame of the strip; holding it down (or pressing Grab) and then moving the mouse changes the ending frame within the strip:
 - Dragging the right arrow to the left shortens the clip; any original images at the tail are ignored. Use this to quickly clip off a rolldown.
 - Dragging the right arrow right extends the clip. For movies and images sequences, more of the animation is used until exhausted. Extending a clip beyond its end results in Blender making a copy of the last image. Use this for transitions out of this clip.

Multiple selection

You can select several (handles of) strips by ⇧ Shift RMB -clicking: when you'll hit G, everything that's selected will move with your mouse – this means that, for example, you can at the same time move a strip, shorten two others, and extend a forth one.


- STRIP EXTEND. With a number of Image strips selected, pressing E enters EXTEND mode. All selected strip handles to the "mouse side" of the current frame indicator will transform together, allowing you to essentially extend the strips that fall exactly on the current frame marker and having all others adjust to compensate.

While splicing two strips happens just by placing them finish-to-start, cut a strip by pressing K to cut. At the selected frame for the selected strips, K cuts them in two. Use Cut to trim off roll-ups or lead-ins, or roll-downs or extra film shot ("C" was already taken for Change).

Note on the 'cut'

When you 'cut' a strip, you don't really make a cut like it was with the 'old editing' on real film. In fact, you make a copy of the strip: the end of the original one is 'winded' to the cut point, as with the beginning of the new copy.

For example, imagine that you have a strip of **50** frames, and that you want to delete the first ten ones. You have to go to the **11th** frame, and hit K; the cut 'divides' your strip in two parts. You now can select the first small part (frames **1** to **10**), and delete it hitting X.

You might think that you have really erased the frames **1** to **10**, but there are still there, 'winded', as in a film reel, under your frame **11**: you just have deleted one of the tow copies of your strip created by the 'cut'. And you can at any time get your 'lost' frames back (just RMB -click on the left arrow of the strip, then G grab it to the left to display the desired number of frames again (or to the right to 'hide' more frames – this is another way to remove frames at the beginning/end of a strip!).

This is at the heart of nearly every editor solution, and that's quite handy!

Action Stops

When extending the start beyond the beginning or end after the ending, keep in mind that only the last image copies, so when viewed, action will stop on that frame. Start your transition (fade, cross) a little early while action is still happening so that the stop action is not that noticeable (unless, of course, you want it to be, like the 80's drama sitcoms).

Change the length of an effect strip by changing the start/end frame of the origin strips.

Copy and Paste

You can copy a clip and paste it using the two header buttons.

Meta Strips

A Meta-Strip is a group of strips. Select all the strips you want to group, and Make them into one meta. The meta spans from the beginning of the first strip to the end of the last one, and condenses all channels into a single strip, just like doing a mixdown in audio software. Separating (ungrouping) them restores them to their relative positions and channels.

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Proposed fixes: none

Sequence Display Modes

By default, the VSE only displays the sequencer. Several options in the header bar allow you change the editor to display the sequence in real time, and in various ways.

The second button will change the editor to display only the preview, and the third button displays both the sequencer and the preview

the VSE workspace can show you different aspects of the composite result, for the current frame:

- Image/Sequence: Colors (what you see)
- Chroma: Color hue and saturation
- Luma: Brightness/contrast
- Histogram: Levels of red, green, and blue

In the Chroma, Luma, and Image modes, a channel selector appears; channel 0 is the result of compositing the strips with their special effects strips. Channel 1 is what the current frame's image from the strip in channel 1 looks like (channel 1 is at the bottom of the heap). The display of these modes is either the composite (channel 0) or the frame from the strip (channels 1 through n).

Zoom the view of any of these workspaces by scrolling your middle mouse wheel.

Image Preview

In the upper window pane of the Sequence screen layout is another VSE window, this one set to Image Preview mode. It shows you what the resulting video will look like when saved. This is the main working mode for adding strips and moving them around, cutting, grouping (making meta) and splicing them through special effects.

Luma Waveform

For the selected channel, brightness, or luminosity, is mapped with this display.

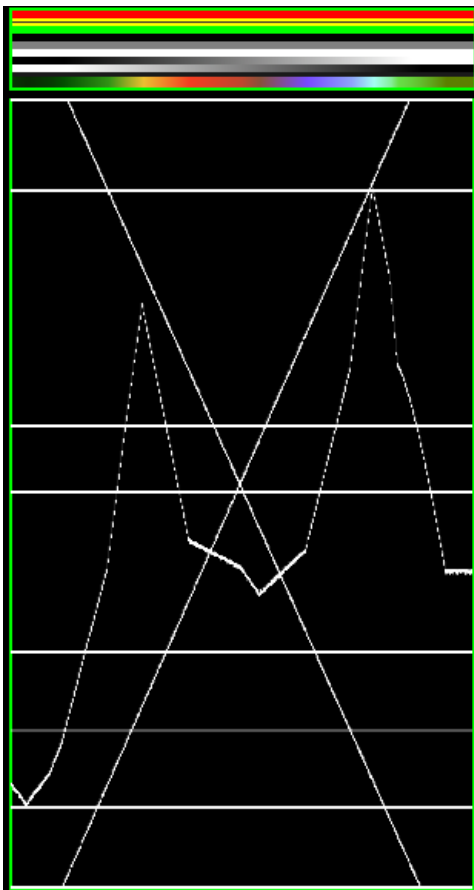
A luma waveform allows you to judge the quality of the luminance distribution across your video signal, you can view a luma-waveform instead of the usual output display on every control monitor.

The display plots for every scanline the luminance value. The lines are all drawn on top of each other. The points get brighter if the lines cross (which is very likely with several hundred scanlines). You will understand the picture most easily if you plug an oscilloscope to the Luma-video-output of your television set. It will basically look the same.

In this mode, the vertical axis represents the luminosity: 0 at the bottom, 1 at the top; the horizontal axis is a mapping from the horizontal axis of the frame. There are as much curves as scanlines in the frame: each one of this curves represents the luminosity of the pixels of one line. Moreover, the color of a pixel in this mode represents the number of pixels from the matching column of the frame sharing the same luminosity – i.e. the number of curves that cross at this point (black/transparent, for no pixel, white/opaque for at least 3 pixels).

This mode is good for:

- If the waveform does not fill the whole picture you might want to play with the "setup" and "gain" master-sliders in the "gamma"-plugin until it fills the whole picture (contrast autostretch).
- With the more advanced gamma-plugin you can decide where you have to desaturate (especially in dark regions).
- You can judge if you want to dump the whole thing since it is completely distorted and clips at the top or the bottom.



'Simple' picture.

The various horizontal lines in the Luma waveform match the uniform-color lines of the picture.

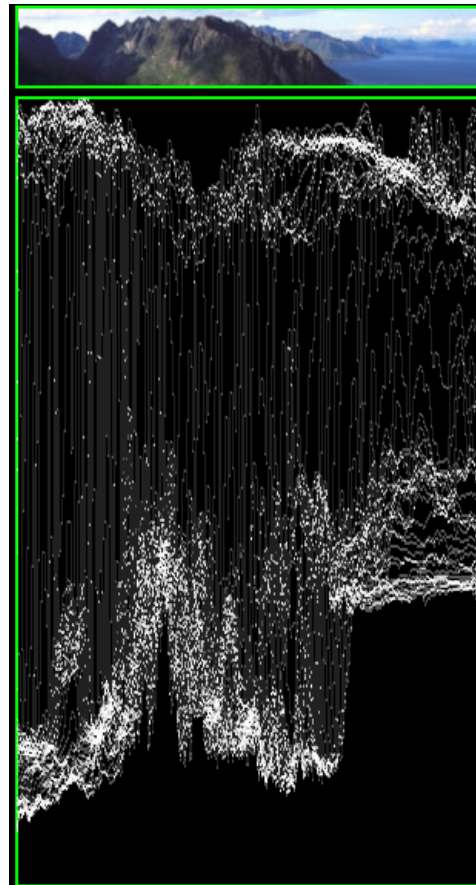
Note that the 'grey 20%' one-pixel width line (inside the yellow strip) is represented in the Luma waveform by a grey line.

The two lines drawing an 'X' are from the two linear tone shades (white→black and black→white).

Finally, the broken line matches the complex tone shade at the bottom of the picture.

Examples of VSE Luma Previews.

Note that the pictures (first green frame, at the top) are only 50px high, to limit the number of curves displayed in the Luma waveform!



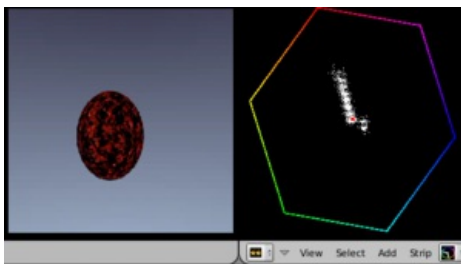
A 'real' picture.

The curves are quite visible.

We found a luma of 80-100% for the sky, a luma around 40% for the sea, and a luma of 10-20% for the mountains, growing around 40% for the sunny part.

Use this display to check for appropriate contrast and luminosity across all frames in the channel. When spots in the film that should have even illumination don't, it looks like a flashbulb went off or an extra light was suddenly turned on. This can happen if two strips were rendered or shot under different lighting conditions but are supposed to be contiguous.

Chroma Vectorscope



Example VSE Chroma Preview

Use this mode judge the quality of the color-distribution and saturation, you can also view a U/V scatter-plot.

The picture is converted to YUV-format. The U- and V-values represent the angle of the color. For pixel of the picture, one point is plotted in the display at the U and V-value-position. If several pixels happen to have the same U/V-value the pixel in the plot gets brighter.

To help you understand what color is meant, a hexagram marking the extreme positions (red, magenta, blue, cyan, green, yellow) is drawn and a red cross to mark the origin.

In other words, for the selected channel, this display shows the color space of the image inside a hexagon. Each point of the hexagon is a primary color: red, magenta, blue, cyan, green, and yellow. Black is at the center, and overall saturation is scaled as dots closer to the outside. The example to the right shows that the image has a lot of red (50% saturation) and small amount of blue, with no green.

Always: remember to activate an additional control monitor of the end result. Color calibration is a matter of taste and depends on what you want.

Use this display to check for too much color saturation. While over-saturated images look great for op-art and computer displays, they stink when shown on the big screen TV. Use the Alt-Animation key to scrub the video; this display will update with a new/revised map for each frame. Just like watching the Image preview to see what it looks like, watch the Chroma Vectorscope to watch for color use.

This mode is good for:

- If your picture looks very moody or desaturated you might want to take a look at the U/V-plot. You will most likely see all pixels building a crowd at the origin. If you add saturation using the "gamma"-plugin you can see in the U/V-plot if you distort the color.
- If you do color-matching on a by hand basis you can match the angle you see of different channels monitors.

Histogram

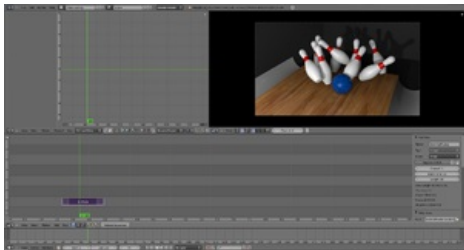
This mode displays a graph showing the distribution of color information in the pixels of the currently displayed image. The X-axis represents values of pixel, from 0 to 1 (or 0 to 255), while the Y-axis represents the number of pixels in that tonal range. A predominantly dark image would have most of its information toward the left side of the graph.

Use this mode to balance out the tonal range in an image. A well balanced image should have a nice smooth distribution of color values.

Page status ([reviewing guidelines](#))

Partial page Text need all
Proposed fixes: none

Sequencer Screen Layout



Default Video Editing screen lay out

Page status ([reviewing guidelines](#))

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Proposed fixes: none

Sequencer Effects

Blender offers 16 built effects that are built into Blender, and are therefore universal. Some operate on two strips; some on one, and some create a new strip. Each effect enhances your content in some way or allows professional-quality transitions.

Add



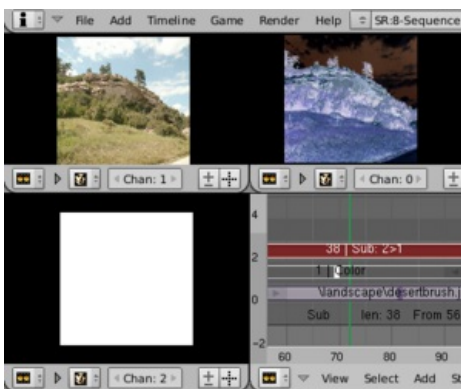
Can you hear the thunder?

The Add effect adds two colors together. Red and Cyan (Green and Blue) make White. Red and Blue make "Magenta" (i.e. Purple!). Red and Green make Yellow.

The Add Effect adds the colors of two strips together. Use this effect with a base image strip, and a modifier strip. The modifier strip is either a solid color or a black-and-white mask, or another image entirely. The example to the right shows what happens when you add gray to an image, and animate the effect over time. The image gets bright because we are adding gray (R:.5, G:.5, B:.5) to say, a blue color (R:1, G:1, B:5) resulting in (R:6, G:6, B:10) which retains the original hue (relationship between the colors) but is much brighter (has a higher value). When applied to the whole image like this, the whole image seems to flash.

You can use this effect to increase the brightness of an image, or if you use a BW mask, selectively increase the brightness of certain areas of the image. The Mix node, in Add mode, does exactly the same thing as the Add sfx strip here, and is controlled the same way by feeding the Factor input.

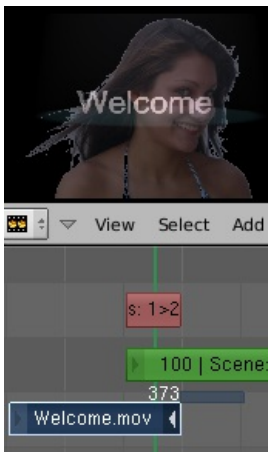
Subtract Effect



Subtract Effect

This effect takes away one strip's color from the second. Make a negative of an image using this effect, or switch the order of the strips and just darken the strip. Subtracting a hue of blue from a white image will make it yellow, since red and green make yellow.

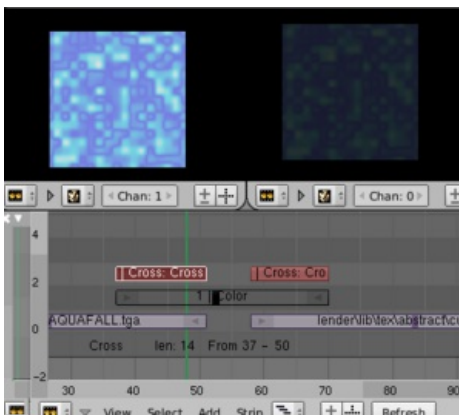
Cross and Gamma Cross



This effect fades from one strip to another, based on how many frames the two strips overlap. This is a very useful strip that blends the whole image from one to the other.

Gamma Cross uses color correction in doing the fade, resulting in a smooth transition that is easier on the eye.

Fade to Black

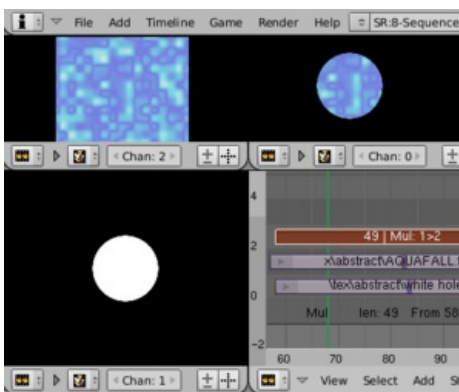


Cross-Fade between Black

Many scenes fade to black, and then fade in from black, rather than directly from one to the other.

The strip setup to do this is shown to the right. The two strips are on Channel 1, and you Add->Color Generator strip to Channel 2, straddling the two main strips. Change the color to black, and add two Cross Effects; the first from Channel 1 to Channel 2 (black), and the second from Channel 2 to Channel 1. The first strip will fade to black, and then the second will fade in from black. Of course, you can use any transition color you want. Black is a relaxing intermediary; red is alarming. Use the dominant color in the second strip to introduce the second strip.

Multiply



Multiply Effect.

The Multiply effect multiplies two colours. Blender uses values between **0.0** and **1.0** for the colours, he doesn't have to normalise this operation, the multiplication of two terms between **0.0** and **1.0** always gives a result between **0.0** and **1.0** (with the 'traditional' representation with three bytes – like RGB(**124**, **255**, **56**) –, the multiplications give far too high results – like RGB(**7316**, **46410**, **1848**) –, that have to be 'brought back', normalised – just by dividing them by **256**! – to 'go back' to range of **0** to **255**...).

This effect has two main usages:

With a mask

A mask is a B&W picture which, after multiplication with a 'normal' image, only shows this one in the white areas of the mask (everything else is black). The opening title sequence to James Bond movies, where the camera is looking down the barrel of a gun at James, is a good example of this effect.

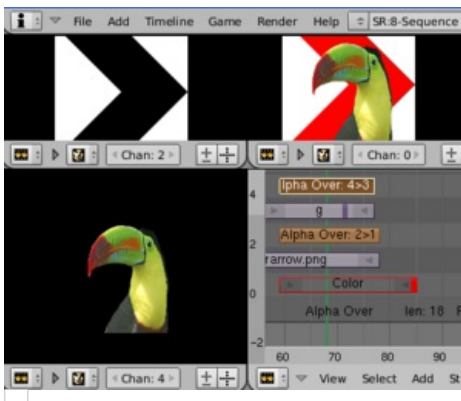
With uniform colors

Multiplying a color with a 'normal' image allows you to soften some hues of this one (and so – symmetrically – to enhance the others). For example, if you have a brown pixel RGB(0.50, 0.29, 0.05), and you multiply it with a cyan filter (uniform color RGB(0.0, 1.0, 1.0)), you'll get a color RGB(0.0, 0.29, 0.5). Visually, the result is to kill the reds and bring up (by 'symmetry' – the real values remain unchanged!) the blues and greens. Physically, it is the same effect as shining a cyan light onto a chocolate bar. Emotionally, vegetation becomes more lush, water becomes more Caribbean and inviting, skies become friendlier.

Note

This effect reduces the global luminosity of the picture (the result will always be smaller than the smallest operand). If one of the images is all white, the result is the other picture; if one of the images is all black, the result is all black!


Alpha Over, Under, and Over Drop



AlphaOver Effect

Using the alpha (transparency channel), this effect composites a result based on transparent areas of the dominant image. If you use a Scene strip, the areas of the image where there isn't anything solid are transparent; they have an alpha value of 0. If you use a movie strip, that movie has an alpha value of 1 (completely opaque).

So, you can use the Alpha Over/Alpha Under effect to composite the CGI Scene on top of your movie. The result is your model doing whatever as if it was part of the movie. The Factor curve controls how much the foreground is mixed over the background, fading in the foreground on top of the background. The colors of transparent foreground image areas are ignored and does not change the color of the background.

Select two strips (⇧ Shift RMB 

- With Alpha Over, the strips are layered up in the order selected; the first strip selected is the background, and the second one goes over the first one selected. The Factor controls *the transparency of the foreground*, i.e. a Fac of 0.0 will only show the background, and a Fac of 1.0 will completely override the background with the foreground (except in the transparent areas of this one, of course!)
- With Alpha Under, this is the contrary: the first strip selected is the foreground, and the second one, the background. Moreover, the Factor controls *the transparency of the background*, i.e. a Fac of 0.0 will only show the foreground (the background is completely transparent), and a Fac of 1.0 will give the same results as with Alpha Over.
- Alpha Over Drop is between the two others: as with Alpha Under, the first strip selected will be the foreground, but as with Alpha Over, the Factor controls the transparency of this foreground.

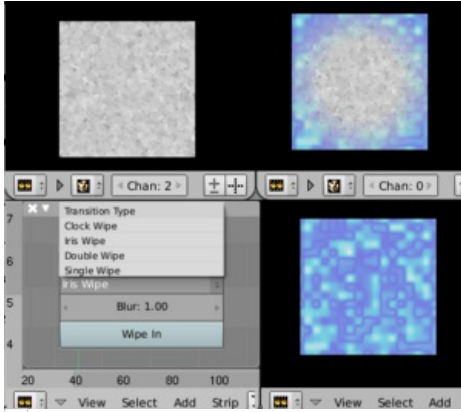
The example shows layering of AlphaOver effects. The very bottom channel is red, and an arrow is on top of that. Those two are AlphaOver to Channel 3. My favorite toucan is Channel 4, and Channel 5 alphaovers the toucan on top of the composited red arrow. The last effect added is tied to Channel 0 which will be rendered.

By clicking the PreMult Alpha button in the properties panel of the foreground strip, the Alpha values of the two strips are not multiplied or added together. Use this effect when adding a foreground strip that has a variable alpha channel (some opaque areas, some transparent, some in between) over a strip that has a flat opaque (Alpha=1.0 or greater) channel. If you notice a glow around your foreground objects, or strange transparent areas of your foreground object when using AlphaOver, enable PreMultiply. The AlphaOver Drop effect is much like the Cross, but puts preference to the top or second image, giving more of a gradual overlay effect than a blend like the Cross does. Of course, all of the Alpha effects respect the alpha (transparency) channel, whereas Cross does not.

The degree of Alpha applied, and thus color mixing, can be controlled by an F-curve. Creating a Sine wave could have the effect of the

foreground fading in and out.

Wipe



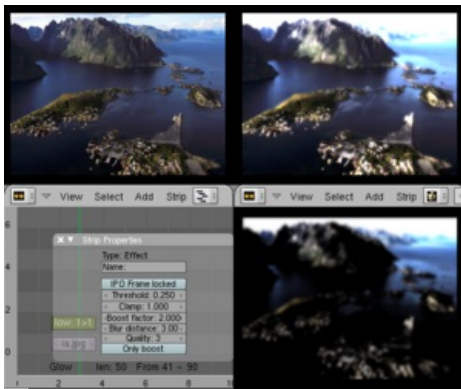
VSE Wipe Built-in Effect

Wipe transitions from one strip to another. This very flexible effect has four transition types:

- Clock: like the hands of an analog clock, it sweeps clockwise or (if Wipe In is enabled) counterclockwise from the 9:00 position. As it sweeps, it reveals the next strip.
- Iris: like the iris of a camera or eye, it reveals the next strip through an expanding (or contracting) circle. You can blur the transition, so it looks like ink bleeding through a paper.
- Double Wipe: Starts in the middle and wipes outward, revealing the next strip. It can also Wipe In, which means it starts at the outside and works its way toward the middle. You can angle and blur the wipe direction as well.
- Single Wipe: Reveals the next strip by uncovering it. Controls include an angle control so you can start at a corner or side, and blur the transition.

Note: some older plugins contain similar functionality.

Glow



Example of a Glow effect applied to a picture.

Top left: base picture (Lofoten Islands, Norway – source: wikipedia.fr);

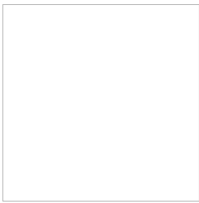
Top right: result of the effect;

Bottom left: effect settings;

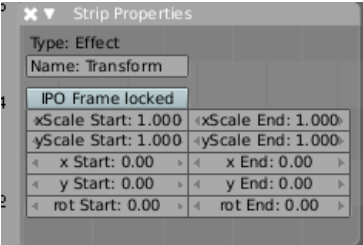
Bottom right: result with the Only boost button activated.

This effect makes parts of an image glow brighter by working on the luminance channel of an image. The Glow is the superposition of the base image and a modified version, where some areas (brighter than the Threshold:) are blurred. With the Glow strip properties, you control this Threshold:, the maximum luminosity that can be added (Clamp:), a Boost factor: for it, the size of the blur (Blur distance:), and its Quality:. The Only boost button allows you to only show/use the 'modified' version of the image, without the base one. To "animate" the glow effect, mix it with the base image using the Gamma Cross effect, crossing from the base image to the glowing one.

Transform



(Note: Transform does not work in Blender 2.49) Transform is a swiss-army knife of image manipulation. It scales, shifts, and rotates the images within a strip. The example to the right shows what can be done with a single image. To make a smooth transition to the final effect, enable the Frame locked button and define a curve in the Ipo Window (Sequence mode).



With the Transform strip selected, uses the properties panel to adjust the settings of this effect:

- (x,y)Scale (Start,End):
To adjust the scale (size). xScale Start defines the start width, xScale End the end width, yScale Start the start height, and yScale End the end height. The values higher than **1.0** will scale up the picture, while values lower than **1.0** will scale it down.
- (x,y) (Start,End):
To adjust the position (shifting). x Start defines the horizontal start position, x End, the end one; positive values shift the image to the right, negative values, to the left. y Start defines the vertical start position, y End, the end one; positive values shift the picture to the top, negative values, to the bottom.
- rot (Start,End):
The rotation is in degrees (**360** for a full turn) and is counter-clockwise. To make an image spin clockwise, make the end value lower than the start one (e.g. start it at 360 and go down from there).

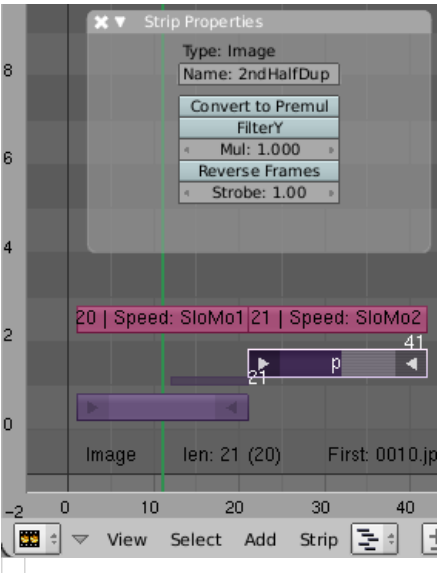
Color

This effect works by itself to create a color strip. By default, when it is created, it is 50 frames long, but you can extend it by grabbing and moving one of the ends. Click on the color swatch in the Effect panel under Sequencer buttons, which is under the Scene (F10) tab, to pick a different color (by default, it is gray). Use this strip crossed with your main movie to provide a fade-in or fade-out.

Speed Control

Speed Control time-warps the strip, making it play faster or slower than it normally would. A Global Speed less than 1.0 makes the strip play slower; greater than 1.0 makes it play faster. Playing faster means that some frames are skipped, and the strip will run out of frames before the end frame. When the strip runs out of frames to display, it will just keep repeating the last one; action will appear to freeze. To avoid this, position the next strip under the original at a point where you want motion to continue.

Creating a Slow-Motion Effect



50% Slow motion using Speed Control

Suppose you want to sssssloooow your strip downwwwwwn. You need to affect the speed of the video clip without affecting the overall frame rate. Select the clip and Add->Effect->Speed Control effect strip. Click to drop it and press N to get the Properties. Set the Global Speed to be the factor by which you want to adjust the speed. To cut the displayed speed by 50%, enter 0.50. Now, a 30-frame clip will play at half speed, and thus display only the first 15 frames.

If you want the remaining frames to show in slo-mo after the first set is displayed, Kcut the strip in two, offset the second part (because the first slow-mo will actually run for more time/frames than shown), and add another Speed control as shown to the right. When the strip on Channel 1, as modified by the sfx strip on Channel 3 finishes, the strip selected on channel 2 starts, as modified by its sfx speed control in channel 3. The trick in creating the second strip is to

- Select the original strip and ⇧ ShiftDuplicate it. In this case, it is a 20-frame image set.
- Drag the clone to half-way above the original and drop it.
- Select the left handle (start), grab it, and move it over half-way. This changes the start frame offset; the strip will now start playing at frame 11 (relative to within itself)
- Select the right handle (end), grab it and move it over half-again as much (in this case, 10 frames) This sets the duration to be 20 frames within your video.
- Add a 50% Speed Control for the first strip, and a 100% speed control for the second. For the second strip, you are already telling blender to play 10 frames over a 20-frame duration, which is already half speed, so you don't need the speed control to slow it down anymore, just to scale the frames selected to the duration of the clip.

That's it! Set your render to animate (in this example) all 40 frames.

Why not just extend the original clip out, you ask? Well, the Speed Control operates based on the number of frames it is going to show, divided by the number of frames it has to show them over. For example, if a strip has 20 frames in it, and you specify a speed factor of 50%, it knows it has to display 10 frames. If that strip is, say, stretched to cover 30 frames of video, it will play each of the 10 frames for 3 frames ($3 \times 10 = 30$). Understanding the math will help you be effective and get the control to do what you want it to.

In very simple cases it will also work to just extend the original clip. This is a very nice feature intended for story boarding and for filling gaps. Add a speed control, ignore the Curves and all the other parameters and just extend the right handle of the original clip. Remember that this is only possible, if the underlying clip ends at the right handle position. (If this isn't the case because you used the knife tool to create it, add a meta for the original clip first.).

Frame Matching

To get even finer control over your clip timing, you can use curves! This can be done in several ways.

- In the default configuration, your F-curve simply map input to output frame scaled down to the range of [0-100] [0-1] in F-curve coordinates. This is enough, if you want to add simple flickering effects.

The speed effect can do even more for you. You can do actual frame matching! That means: you have a certain position at which a certain frame should get displayed (maybe when matching your video track to an audio track) and blender will adjust the speed of the clip smoothly to make this happen.

- You can disable scaling in X direction by clicking on "frame locking". That means: input frame numbers are identical to F-curve X-coordinates.
- You can disable scaling in Y direction by disabling "Scaling [0-1]". That means: output frame numbers are identical to the F-curve Y-coordinates.

After that, use the N-keys window fo the Graph-window to place your control points in a frame exact way.

Changing Video Frame Rates

You can use the speed control to change the frames per second (fps), or framerate, of a video. If you are rendering your video to a sequence set, you can effectively increase or decrease the number of individual image files created, by using a Global Speed value less than or greater than one, respectively. For example, if you captured a five-minute video at 30 fps and wanted to transfer that to film, which runs at 24 fps, you would enter a Global Speed of $30/24$, or 1.25 (and Enable Frame Blending to give that film blur feel). Instead of producing $5 \times 60 \times 30 = 9000$ frames, Blender would produce $9000/1.25 = 7200 = 5 \times 60 \times 24$ frames. In this case, you set a Sta:1 and End:7200, set your Format output to Jpeg, 30fps, and image files 0001.jpg through 7200.jpg would be rendered out, but those images 'cover' the entire 9000 frames. The image file 7200.jpg is the same a frame 9000. When you read those images back into your film .blend at 24 fps, the strip will last exactly 5 minutes.

Multicam Selector

Adjustment Layer

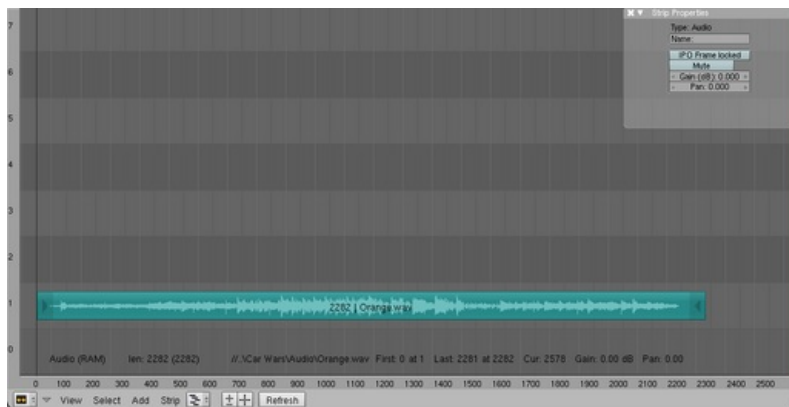
Page status ([reviewing guidelines](#))

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Proposed fixes: none

Sound Editing

Blender contains a multi-track Audio sequencing toolbox. You can add WAV, Mp3 files from your hard disk as a file, or as encoded within a movie, and mix them using an F-Curve as a volume control.



A sound strip in the sequence editor.

Options

Audio-RAM loads a file into memory and plays it from there. You can only load stand-alone WAV files. Audio-HD plays the sound back from the hard disk and thus does not take up memory. With Audio HD, you can load stand-alone WAV files, but also audio tracks from movies.

For either, a green audio strip will be created. With Audio RAM, a waveform is created that shows you the waveform inside the green strip, scaled to the height of the green strip. Since Audio-RAM files are read into memory, changing the audio file will not affect playback, and you will have to re-open the file so that Blender re-reads the file.

Hiss, Crackle and Pop


Some audiophile users report that Hiss is introduced sometimes if Audio RAM is used. There must be some decoding or sampling going on, that does not occur when Audio HD is used, that introduces some playback noise. If you hear pops and crackles, usually that is a sign that your hardware cannot keep up in real-time playback. They will not be present in your final rendered animation output (but they may show up in Game mode). Also, static hiss seems to occur whenever two or more audio strips are overlapping in the timeline...

Audio Mixing in the VSE


You can have as many Audio strips as you wish and the result will be the mixing of all of them. You can give each strip its own name and Gain (in dB) via the N menu. This also let you set a strip to mute or 'Pan' it; -1 is hard left, +1 is hard right, with percentages in-between.


Overlapping strips are automatically mixed down during ANIM processing. For example, you can have the announcer on channel 5, background music on channel 6, and foley sound effects on channel 7.

Working with Audio Tracks

An audio track (strip) is just like any other strip in the VSE. You can grab and move it, adjust its starting offset using RMB  over the arrow end handles, and K cut it into pieces. A useful example is cutting out the "um's" and dead voice time.

Animating Audio Track Properties

You want to set a value somewhere between 0.0 and 1.0, and the volume becomes that percent; 0.6 is 60%. You can add a gain to the volume through the strip properties (N). You can make a curve by having multiple points, to vary the volume over its length. Press  Tab to edit the curve, just like any old bezier F-curve.

In the Y direction, 1.0 is full volume, 0.0 is completely silent. Only the FFMPEG-output system is currently able to mix audio and video into one output stream. Use Ctrl LMB  to add control points, and ⇐ Tab to edit a curve.

Animating an audio strip affects the volume of the strip in the resulting composite. Use animation on an audio strip to fade in/out background music or to adjust volume levels. Layered/crossed audio strips are added together; the lower channel does not override and cut out higher channels. This makes Blender an audio mixer. By adding audio tracks and using the curves to adjust each tracks' sound level, you have an automated dynamic multi-track audio mixer!

Output

The output is therefore a video file if the ANIMATION button in the Render Panel of the Scene Context/Render Sub-context is used as described before. An audio file may be created via the MIXDOWN button in the Sequencer button of the Scene Context, Sound Sub-context. This WAV file contains the full audio sequence and is created in the same directory of the video file and with the same name but with a .WAV extension. You can mix Video and Audio later on with an external program or by adding it to, for example, an image sequence strip as described above.

The advantage of using Blender's sequence editor lies in the easier synchronization attainable by sequencing frames and sound in the same application.

To enable audio synchronisation after importing an audio track, select the Scene button (F10) in the buttons window then choose the Sound Block Button (small blue sine wave). In here you'll see the Sync and Scrub tools.

- Sync lets Blender drop image frames to keep up with realtime audio when you play an animation in the 3D window. This gives you a rough overview of the timing of your animation.
- Scrub allows you to drag your frame-marker or change frames in any window and it will play a clip of audio for that point in time.

Dragging the frame-marker over a range of frames in the Action Editor will allow you to hear roughly where specific sounds occur so that you can key poses or shapes on this frame.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

Retrieved from "<http://wiki.blender.org/index.php/Doc:2.6/Manual/Extensions>"

Doc:2.6/Manual

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Blender 2.6, Python Manual

Introduction

Welcome to the Blender 2.6 Python Manual.

Python www.Python.org is an interpreted, interactive, object-oriented programming language. It incorporates modules, exceptions, dynamic typing, very high level dynamic data types, and classes. Python combines remarkable power with very clear syntax. Python scripts are a powerful and versatile way to extend Blender functionality. Most areas of Blender can be scripted, including Animation, Rendering, Import and Export, Object Creation and the scripting of repetitive tasks.

To interact with Blender, scripts can make use of the tightly integrated API (Application Programming Interface).

General information

Links that are useful while writing scripts.

- [Blender Python API](#)
 - Official API documentation. Use this for referencing while writing scripts.
- [API introduction](#)
 - A short introduction to get you started with the API. Contains examples.
- [CookBook](#)
 - A section of handy code snippets (yet to be written)
- [FAQ](#)
 - Frequently asked questions and their answers

Links that deal with distributing your scripts.

- [Sharing scripts](#)
 - Information on how to share your scripts and get them included in the official Blender distribution.
- [Creating Add-Ons](#)
 - As of Blender 2.5 Alpha1, this is the new way to spread scripts for Blender.
- [Extensions project](#)
 - Project to maintain a central repository of extensions to Blender.

Getting Started - Wiki tutorials

The following pages are located on this wiki and take you from the basics to the more advanced concepts of Python scripting for Blender.

- [Hello World](#)
- [Console](#)
- [Text editor](#)
- [Geometry](#)
- [Properties, ID-Properties and their differences](#)

Getting Started - External links

The following pages are not located on this wiki, but contain a lot of good information to start learning how to write scripts for Blender.

- [Introductory tutorial by Satish Goda](#)
 - Takes you from the beginning and teaches how to do basic API manipulations.
- [Ira Krakow's video tutorials](#)
 - First video in a series of video tutorials.
- [Quickstart guide](#)
 - A quickstart guide for people who already have some familiarity with Python and Blender.
- [Examples thread](#)
 - A forum thread containing many short working script examples.
- [Introduction to Python](#)
 - A one hour video tutorial introducing Python and the Blender API.

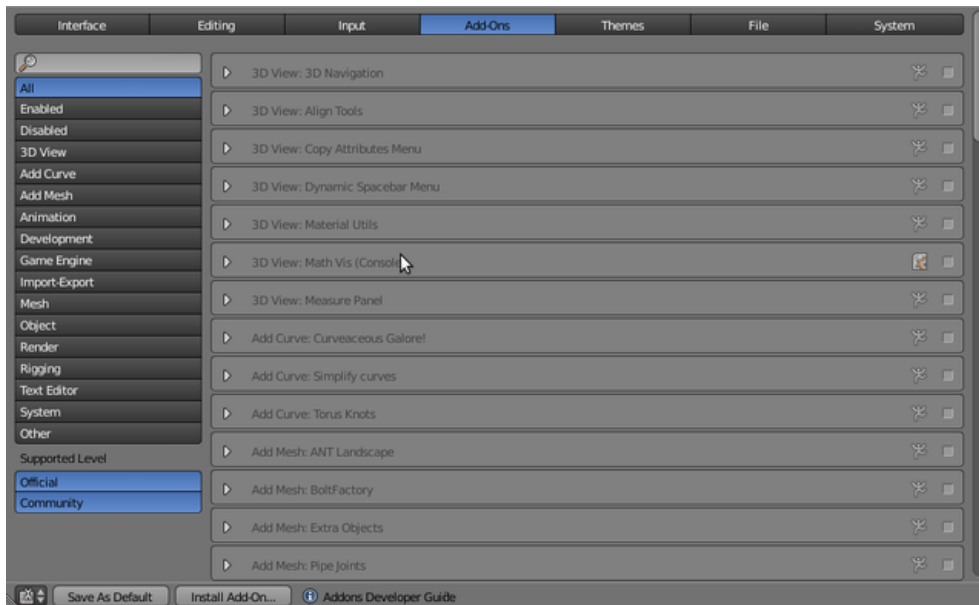
Page status ([reviewing guidelines](#))

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Proposed fixes: none

Add-Ons

Add-On is the general term for any optional script that extends Blender's functionality. They are found in the Add-Ons tab of the User Preferences window. This tab allows to install, enable and disable Add-Ons. Blender comes with some useful Add-Ons already, but you can also add your own, or any interesting ones you find on the web. The [Scripts Catalog](#) provides an index of Add-Ons that are included with Blender as well as listing a number of external Add-Ons.



Installation of an Add-On

For a script to show up in the Add-Ons tab it will first have to be installed. For this you can use the Install Add-On button in the header of the Add-Ons window. Simply click the button and locate the script you wish to install. Once installed, the script will show up in the panel.

Alternatively you can manually install an Add-On. An Add-On is considered installed when it is located in the `../scripts/addons` folder (where `..` is the path to your Blender configuration folder). Simply moving the Add-On into that folder is enough.

Addons can be python scripts **.py** or **.zip** files (containing **.py** scripts).

File locations

- Windows 7 - `C:\Users\%username%\AppData\Roaming\Blender Foundation\Blender\2.5x\scripts\addons`
- Windows XP - `C:\Documents and Settings\%username%\Application Data\Blender Foundation\Blender\2.5x\scripts\addons`
- Linux - `/home/$user/.blender/$version/scripts/addons`

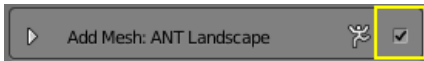
Note that the `AppData` folder in Windows 7 and the `.blender` folder in Linux is hidden. The location may also be different depending on your choices for setting up your operating system and Blender.

You can also create a personal folder containing new addons and configure your files path in the File panel of the User Preferences. To create a personal script folder:

1. Create an empty folder (i.e. 'script_addon_2-6x')
2. Add one folder named 'addons'. It has to be named like this for Blender to recognize it.
3. Put your new addons in this 'addons' folder.
4. open the File panel of the User Preferences.
5. Fill the Scripts entry with the path to your script folder (i.e. 'script_addon_2-6x').

For information on the location of blender directories see: [Configuration & Data Paths](#)

Enabling and Disabling



Enabling an Add-On

Once an Add-On has been installed, it has to be enabled before it can be used. Simply place a check mark on the Enable Add-On box of the Add-On you wish to activate and you're done. The extra functionality of the Add-on is now integrated into Blender and can be used.

To disable the functionality again, uncheck the box. To get more information on a certain Add-on you can press the arrow at the left of the entry and any additional information that is available will be shown. If the Add-On does not activate when enabled, check the [Console window](#) for any errors that may have occurred when loading.



Saving Add-On Preferences

If you want an Add-On to be enabled everytime you start Blender, you will need to save your [User Preferences](#).

Development guidelines

If you are a script developer, you may be interested in the [Add-Ons development guidelines](#).

Page status ([reviewing guidelines](#))

Partial page Text Just started. If you have any suggestions, please add them in the discussion page. Thank you.

Proposed fixes: none

Why another Python tutorial?

This page exists for two reasons.

1. To introduce Programming using Python 3.x quickly and efficiently.
2. And most importantly teach inside of Blender's Console, so you can learn in context.
3. See [External links](#) below

What is Programming?

Programming in simple terms is nothing more than manipulating data. Operations on the data either modifies it, or create new data.

The simplest data is Numbers. Operations on Numbers are addition, Subtraction, multiplication etc., Its the simplest type of data imaginable.

But for solving real world problems, we need have compound data, that is built from simpler data like numbers. A good example is Vector data type, that is built from 3 numbers.

During the course of this tutorial, we will take a look at what data types that Python language provides and how you can create your own custom data for your programs and also write operations that work with that data.

What is Python?

[Python](#) is an interpreted, interactive, object-oriented programming language. It incorporates modules, exceptions, dynamic typing, very high level dynamic data types, and classes. Python combines remarkable power with very clear syntax.

Learning Python is also very easy, even if you have never programmed before.

Python Interpreter

All the exercises in this tutorial will be using the built-in Console window type in Blender 2.6, which has a Python 3.2 interpreter embedded in it.

Following is a video that shows how you can switch to the interpreter.

```
* Python Interactive Console 3.1 (r31:73572, Jul 15 2009, 00:17:53) [MSC v.1500 32 bit (Intel)] *
Command History: Up/Down Arrow
Cursor: Left/Right Home/End
Remove: Backspace/Delete
Execute: Enter
Autocomplete: Ctrl+Space
Ctrl +/- Wheel: Zoom
Builtin Modules: bpy, bpy.data, bpy.ops, bpy.props, bpy.types, bpy.context, Mathutils, Geometry, BGL

>>> |
```

You can start typing Python commands, expressions and statements at the interpreter prompt `>>>`

Hello World

Let's get started with the classical "Hello World" program.

Type the following print statement at the interpreter prompt and press ↵ Enter key.

```
>>> print("Hello World")
Hello World
>>> |
```

Let's break down the above statement.

1. "Hello World" is a string [literal](#) in Python.
 1. A string is a sequence of characters (numbers, alphabets, special characters)
2. `print()` is a built-in function in Python to print output.
3. `print("Hello World")` outputs *Hello World* to the console.

Exercise

Type the following commands and check the output

```
print('"Hello World"')
print("'Hello \n World'")
```

In Python, a string literal can be multiplied by a *number*. By doing so we are repeating the string by the count specified by *number*

- `number * string literal`
- `string literal * number`
- `*` is the multiplication operator in Python

```
>>> print("Hello World " * 10)
Hello World Hello World Hello World Hello World Hello W
orld Hello World Hello World Hello World Hello World
>>> |
```

Note

Check out [all the above examples in one place](#)

External links

Webpages

- <http://www.sthurlow.com/python/>

Video Tutorials

- If you want to learn Python programming in general, have a look at this tutorials

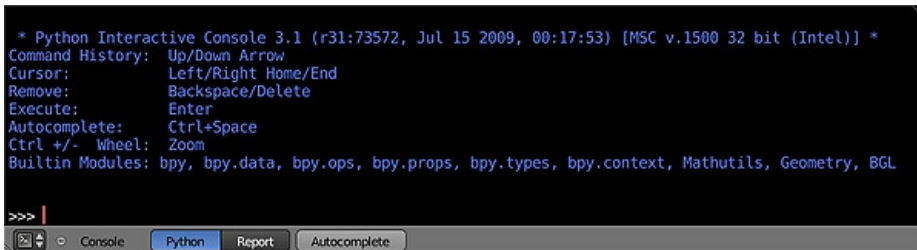
The Console Editor Type

The interactive console in Blender 2.5 has been improved. Auto Complete, Python Reporting & more features have been added. Testing one-liners in the console is a good way to learn the Python API.

Accessing Built-in Python Console

Launching the Console using mouse.

By pressing \diamond ShiftF4 in any Blender Editor Type (3D View, Timeline etc..) you can change it to a Console Editor.



```
* Python Interactive Console 3.1 (r31:73572, Jul 15 2009, 00:17:53) [MSC v.1500 32 bit (Intel)] *
Command History: Up/Down Arrow
Cursor: Left/Right Home/End
Remove: Backspace/Delete
Execute: Enter
Autocomplete: Ctrl+Space
Ctrl +/- Wheel: Zoom
Builtin Modules: bpy, bpy.data, bpy.ops, bpy.props, bpy.types, bpy.context, Mathutils, Geometry, BGL

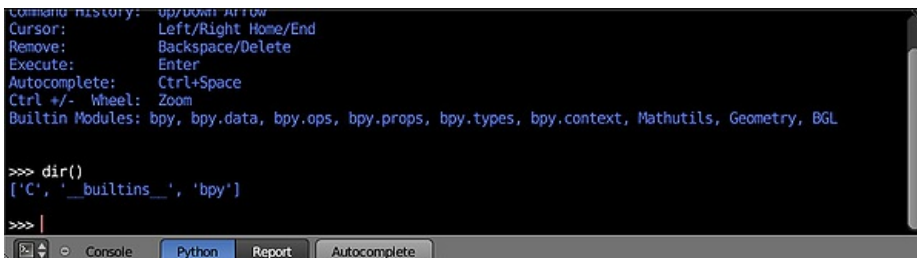
>>> |
```

From the screen shot above, you will notice that apart from the usual hot keys that are used to navigate, by pressing CtrlSpace you can enable Auto-complete feature.

Since Blender 2.5 uses Python 3.x, the interpreter is loaded and is ready to accept commands at the prompt >>>

First look at the Console Environment

To check what is loaded into the interpreter environment, type dir() at the prompt and execute it.



```
>>> dir()
['C', '__builtins__', 'bpy']

>>> |
```

Following is a quick overview of the output

- 'C'
Quick access to bpy.context
- 'D'
Quick access to bpy.data
- '__builtins__'
Python Built-ins (Classes, functions, variables)
- 'bpy'

Top level Blender Python API module.

Auto Completion at work

Now, type bpy. and then press CtrlSpace and you will see the Console auto-complete feature in action.

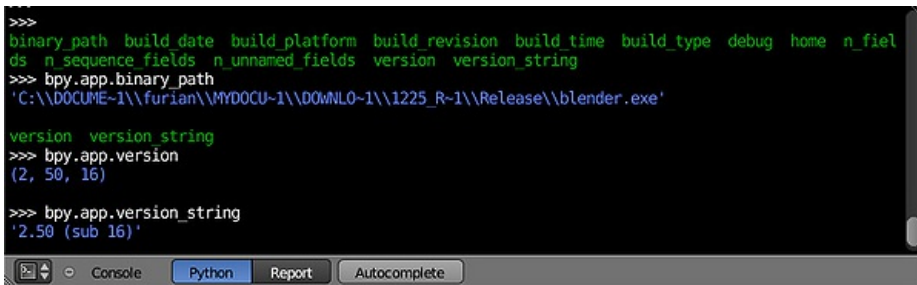


```
app context data ops props types utils
>>> bpy.
```

The screenshot shows the Blender Python console with the 'Autocomplete' button highlighted. Above the prompt, a list of modules is displayed: app, context, data, ops, props, types, and utils.

You will notice that a list of sub-modules inside of bpy appear. These modules encapsulate all that we can do with Blender Python API and are very powerful tools.

Lets list all the contents of bpy.app module.



```
>>>
binary_path build_date build_platform build_revision build_time build_type debug home n_fiel
ds n_sequence_fields n_unnamed_fields version version_string
>>> bpy.app.binary_path
'C:\DOCUMENT~1\furian\MYDOCU~1\DOWNLO~1\1225_R~1\Release\blender.exe'

version version_string
>>> bpy.app.version
(2, 50, 16)

>>> bpy.app.version_string
'2.50 (sub 16)'
```

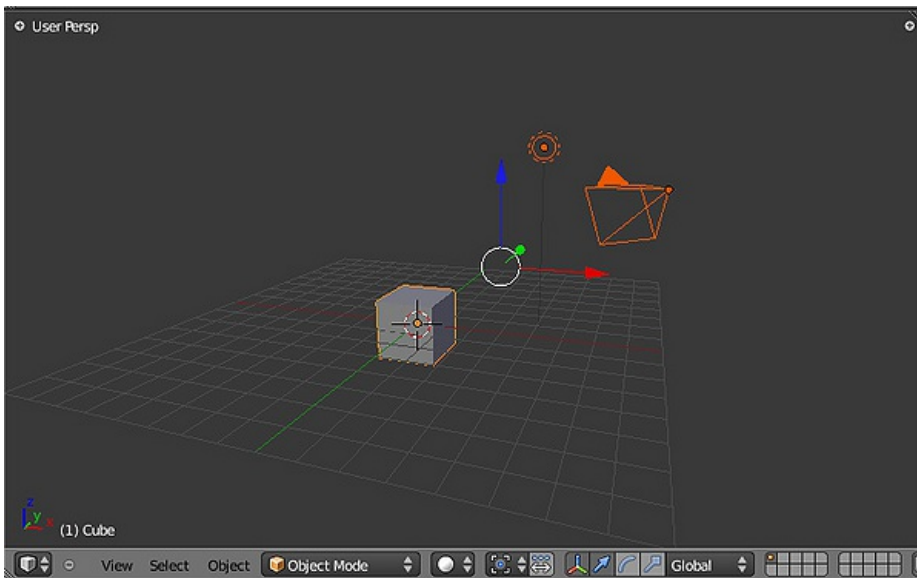
The screenshot shows the Blender Python console with the 'Autocomplete' button highlighted. The output of the commands shows the contents of the bpy.app module, including binary_path, build_date, build_platform, build_revision, build_time, build_type, debug, home, n_fiel, ds, n_sequence_fields, n_unnamed_fields, version, version_string, and version_string.

Notice the green output above the prompt where you enabled auto-completion. What you see is the result of auto completion listing. In the above listing all are module attribute names, but if you see any name end with '('m then that is a function.

We will make use of this a lot to help our learning the API faster. Now that you got a hang of this, lets proceed to investigate some of modules in bpy.

Before tinkering with the modules..

If you look at the 3D Viewport in the default Blender scene, you will notice 3 objects: Cube, Lamp and Camera.



- All objects exist in a context and there can be various modes under which they are operated upon.
- At any instance, only one object is active and there can be more than one selected objects.
- All objects are data in the Blender file.
- There are operators/functions that create and modify these objects.

For all the scenarios listed above (not all were listed, mind you..) the bpy module provides functionality to access and modify data.

Examples

bpy.context

Note

For the commands below to show the proper output, make sure you have selected object(s) in the 3D view.

```
>>> active_base active_bone active_object active_pose_bone area driver_add( edit object editable_
bones get( id_data is_property_hidden( is_property_set( items( keyframe insert( keys( main
manager mode object particle_edit object path_resolve( path to id( recast type( region rna t
type scene screen sculpt object selected_bases selected_bones selected_editable_bases selected
_editable_bones selected_editable_objects selected_objects selected_pose_bones space data textu
re_paint object tool settings user_preferences values( vertex_paint_object visible_bones visib
le_pose_bones weight_paint_object window
>>> bpy.context.mode
'OBJECT'

>>> bpy.context.object
[BPY_StructRNA "Object" -> "Cube"]

active_base active_bone active_object active_pose_bone
>>> bpy.context.active_object
[BPY_StructRNA "Object" -> "Cube"]

selected_bases selected_bones selected_editable_bases selected_editable_bones selected_editable_
objects selected_objects selected_pose_bones
>>> bpy.context.selected_objects
[[BPY_StructRNA "Object" -> "Cube"], [BPY_StructRNA "Object" -> "Lamp"], [BPY_StructRNA "Object" ->
"Camera"]]
```

Try it out!

bpy.context.mode

Will print the current 3D View mode (Object, Edit, Sculpt etc.,)

bpy.context.object or **bpy.context.active_object**

Will give access to the active object in the 3D View

```
>>> bpy.context.object.location.x = 1
```

Change x location to a value of 1

```
>>> bpy.context.object.location.x += 0.5
```

Move object from previous x location by 0.5 unit

```
>>> bpy.context.object.location = [1, 2, 3]
```

Changes x, y, z location

```
>>> bpy.context.object.location.xyz = [1, 2, 3]
```

Same as above

```
>>> type(bpy.context.object.location)
```

Data type of objects location

```
>>> dir(bpy.context.object.location)
```

Now that is a lot of data that you have access to

bpy.context.selected_objects

Will give access to a list of all selected objects.

```
>>> bpy.context.selected_objects then press {{Shortcut|Ctrl|Space}}
```

```
>>> bpy.context.selected_objects[0]
```

Prints out name of first object in the list

```
>>> [object for object in bpy.context.selected_objects if object != bpy.context.object]
```

Complex one.. But this prints a list of objects not including the active object

bpy.data

bpy.data has a bunch of functions and variables that give you access to all the data in the Blender file.

You can access following data in the current Blender file:

objects, meshes, materials, textures, scenes, screens, sounds, scripts, texts, cameras, curves, lamps, brushes, armatures, images, lattices, libraries, worlds, groups, metaballs, particles, node_groups

That's a lot of data.

Try it out!


```
BoolProperty( BoolVectorProperty( CollectionProperty( EnumProperty( FloatProperty( FloatVectorP
roperty( IntProperty( IntVectorProperty( PointerProperty( StringProperty( actions add_image(
armatures bl_rna brushes cameras curves driver add( filename get( gpencil groups id data
images is_property_hidden( is_property_set( items( keyframe insert( keys( lamps lattices lib
raries materials meshes metaballs node_groups objects particles path_resolve( path_to_id( r
ecast_type( rna_type scenes screens scripts sounds texts textures values( vfonts window_ma
nagers worlds
>>> bpy.data
[BPY_StructRNA "Main"]
>>> bpy.data.objects
[BPY_PropertyRNA "Main" -> "objects"]
>>>
>>> for object in bpy.data.objects:
...     print(object.name + " is at location " + str(object.location))
...
Camera is at location [7.481132, -6.507640, 5.343665](vector)
Cube is at location [0.000000, 0.000000, 0.000000](vector)
Lamp is at location [4.076245, 1.005454, 5.903862](vector)
>>> |
```

Exercise

```
>>> for object in bpy.data.scenes['Scene'].objects: print(object.name)
```

↵ Enter twice

Prints the names of all objects belonging to the Blender scene with name "Scene"

```
>>> bpy.data.scenes['Scene'].objects.unlink(bpy.context.active_object)
```

Unlink the active object from the Blender scene named 'Scene'

```
>>> bpy.data.materials['Material'].shadows
```

```
>>> bpy.data.materials['Material'].shadows = False
```

bpy.ops

The tool/action system in Blender 2.5 is built around the concept of operators. These operators can be called directly from console or can be executed by click of a button or packaged in a python script. Very powerful they are..

For a list of various operator categories, click [here](#)

Lets create a set of five Cubes in the 3D Viewport. First, delete the existing Cube object by selecting it and pressing X

Try it out!

The following commands are used to specify that the objects are created in layer 1. So first we define an array variable for later reference:

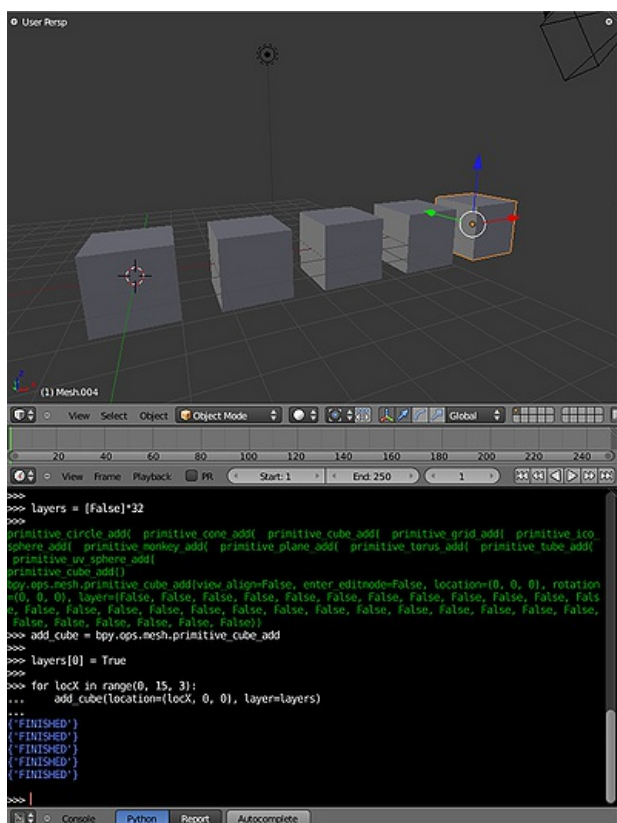
```
>>> mylayers = [False]*20
>>> mylayers[0] = True
```

We create a reference to the operator that is used for creating a cube mesh primitive


```
>>> add_cube = bpy.ops.mesh.primitive_cube_add
```

Now in a for loop, we create the five objects like this (In the screenshot above, I used another method) Press ENTER-KEY twice after entering the command at the shell prompt.

```
>>> for index in range(0, 5):
...     add_cube(location=(index*3, 0, 0), layers=mylayers)
```



The Text Editor

Blender has a Text Editor among its windows types, accessible via the Text Editor button ( Text Editor) of the Window type menu, or via ⇧ ShiftF11.

The newly opened Text window is grey and empty, with a very simple toolbar (*Text Toolbar*).



Text Toolbar.

From left to right there are the standard Window type selection button and the window menus. Then there is the Text ID Block browse button followed by the New button for creating new Text files. Once you click it, you will find that the Toolbar has changed.. for good!



Text Toolbar with a file open

Now you find a textbox to change name of your text file, followed by + button to create new files. To remove the text block, click the X button.

The following three buttons toggle display of line numbers, word-wrap text and syntax highlighting respectively.

Typing on the keyboard produces text in the text buffer. As usual, pressing dragging and releasing LMB  selects text.

The following keyboard commands apply:

- CtrlC - Copies the marked text into the text clipboard.
- CtrlX - Cuts out the marked text into the text clipboard.
- CtrlV - Pastes the text from the clipboard at the cursor location in the Text window.
- ⇧ ShiftCtrlAltS - Saves unsaved text as a text file, a File Browser window appears.
- AltS - Saves an already open file.
- AltO - Loads a text, a File Browser window appears.
- AltP - Executes the text as a Python script.
- CtrlZ - Undo.
- Ctrl⇧ ShiftZ - Redo.
- AltR - Reopen (reloads) the current buffer (all non-saved modifications are lost).
- AltM - Converts the content of the text window into 3D text (max 100 chars).

To delete a text buffer just press the X button next to the buffer's name, just as you do for materials, etc.

The most notable keystroke is AltP which makes the content of the buffer being parsed by the internal Python interpreter built into Blender. The next page will present an example of Python scripting. Before going on it is worth noticing that Blender comes with a fully functional Python interpreter built in, and with a lots of Blender-specific modules, as described in the [API references](#).

The Text Editor has now also some dedicated Python scripts, which add some useful writing tools, like a class/function/variable browser, completion... You can access them through the Text → Text Plugins menu entry.

Other usages for the Text window

The text window is handy also when you want to share your .blend files with the community or with your friends. A Text window can be used to write in a README text explaining the contents of your blender file. Much more handy than having it on a separate application. Be sure to keep it visible when saving! If you are sharing the file with the community and you want to share it under some license you can write the license in a text window.

Demonstration

Exercise

Copy the text below in the Text Editor.

```
import bpy
from math import radians, cos, sin

# An object can exist in 20 layers,
# so the following code determines on which layers you want it to be

# Get the cursor's location
cursor = bpy.context.scene.cursor_location

# Radius of the circle
radius = 5

# Space the cubes around the circle. Default is 36 degrees apart
# Get a list of angles converted to radians

anglesInRadians = [radians(degree) for degree in range(0, 360, 36)]

# Loop through the angles, determine x,y using polar coordinates
# and create object
for theta in anglesInRadians:
    x = cursor.x + radius * cos(theta)
    y = cursor.y + radius * sin(theta)
    z = cursor.z
    bpy.ops.mesh.primitive_cube_add(location=(x, y, z))
```

Execute the script with AltP.

You can see the result of running the above script in this video.

Page status ([reviewing guidelines](#))

Void page

Proposed fixes: none

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Page status ([reviewing guidelines](#))

Partial page

Proposed fixes: none

Introduction

Since we are working with new and improving Python API, if you have something that needs to be answered, please add it here. We will find answers from dev's if we do not know them and provide an answer here.

Geometry

How can I generate a mesh object using the API?

Download this code example [Script_GeneratePyramidMesh.py](#) and run it from the Text Window.

How do I apply a modifier using the API?

```
bpy.ops.object.convert(target='MESH', keep_original=False)
```

All the modifiers in the stack will be applied.

In case you just want to apply only the subsurf modifier and leave others alone, and create a new mesh (Old mesh will retain all its modifiers), the following code shows one way of doing it.

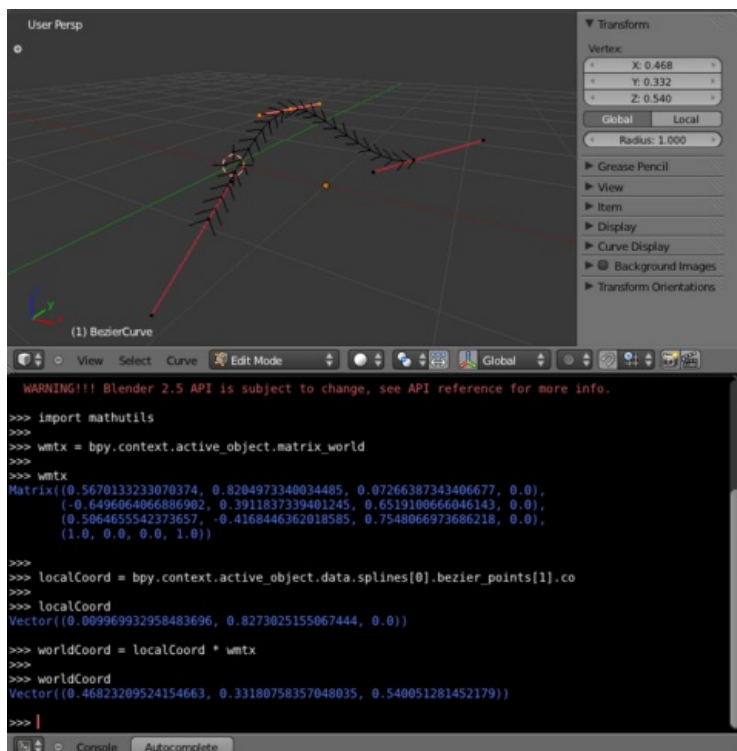
```
for modifier in bpy.context.object.modifiers:
    if modifier.type != 'SUBSURF':
        modifier.show_render=True
bpy.ops.object.convert(target='MESH', '''keep_original=True''')
```

How do I get the world coordinates of a control vertex of a BezierCurve?

```
wmtx = bpy.context.active_object.matrix_world
```

```
localCoord = bpy.context.active_object.data.splines[0].bezier_points[1].co
```

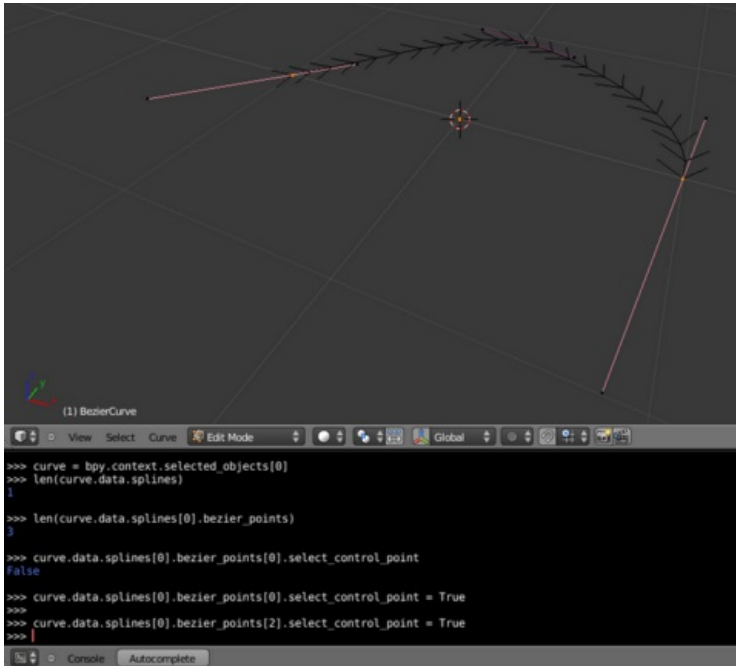
```
worldCoord = localCoord * wmtx
```



[More info...](#)

How do I select/deselect the control points of a Curve

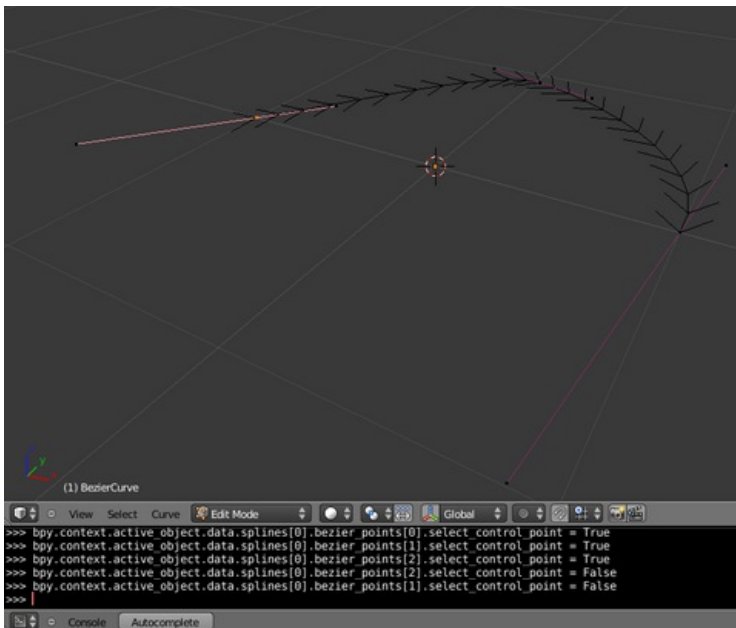
Method 1



```
curve = bpy.context.selected_objects[0]

curve.data.splines[0].bezier_points[0].select_control_point = True
curve.data.splines[0].bezier_points[2].select_control_point = True
```

Method 2



```
bpy.context.active_object.data.splines[0].bezier_points[0].select_control_point = True
```

[More info...](#)

Materials

How to link a mesh/object to a material?

TODO

Customization

How do I automate custom hotkeys?

Blender's Python API

The full Python API (Application Programmer Interface) of Blender is documented here:

[2.60a API](#)

[2.59 API](#)

[2.58 API](#)

[2.57 API](#)

[2.56 API](#)

Scripts

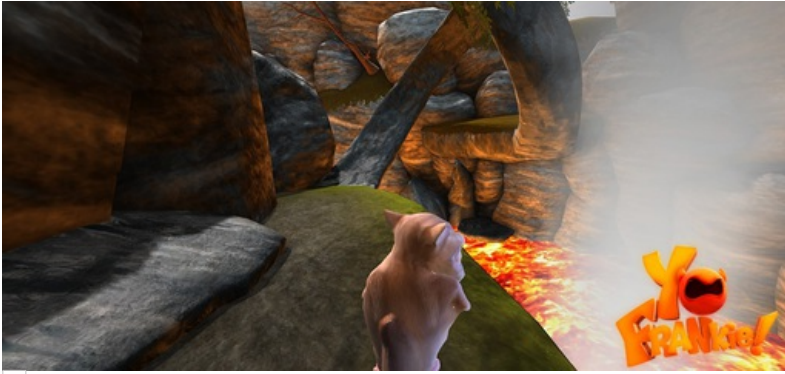
There are more than one hundred different scripts for Blender available on the net.

As with plugins, scripts are very dynamic, changing interface, functionalities and web location fairly quickly, so for an updated list and for a live link to them please refer to one of the two main Blender sites:

- www.blender.org
- www.blenderartists.org
- [Python extensions on this wiki.](#)

Introduction to Game Engine

Blender has its own built in Game Engine that allows you to create interactive 3D applications or simulations. The major difference between Game Engine and the conventional Blender system is in the rendering process. In the normal Blender engine, images and animations are built off-line – once rendered they cannot be modified. Conversely, the Blender Game Engine renders scenes continuously in real-time, and incorporates facilities for user interaction during the rendering process.



Screenshot from "Yo Frankie", produced with Blender Game Engine

The Blender Game Engine oversees a game loop, which processes logic, sound, physics and rendering simulations in sequential order. The engine is written in C++.

By default, the user has access to a powerful, high level, Event Driven [Logic Editor](#) which is comprised of a series of specialised components called "Logic Bricks". The [Logic Editor](#) provides deep interaction with the simulation, and its functionality can be extended through Python scripting. It is designed to abstract the complex engine features into a simple user interface, which does not require experience with Programming. An overview of the [Logic Editor](#) can be found in the [Game Logic Screen Layout](#)

The Game Engine is closely integrated with the existing code base of Blender, which permits quick transitions between the traditional modelling featureset and game-specific functionality provided by the program. In this sense, the Game Engine can be efficiently used in all areas of game design, from prototyping to final release.

The Game Engine can simulate content within Blender, however it also includes the ability to export binary runtimes to Windows, Linux and MacOS. There is also coming support for mobile platforms with the Android BlenderPlayer in 2012.

There are a number of powerful libraries included in the 2.5 / 2.6 releases of Blender including:

- Recast - a state of the art navigation mesh construction toolset for games.
- Detour - a path-finding and spatial reasoning toolkit.
- Bullet - a physics engine featuring 3D collision detection, soft body dynamics, and rigid body dynamics
- Audaspace - a sound library for control of audio. Uses OpenAL or SDL

When creating a game or simulation in the BGE, there are four essential steps:

1. Create visual elements that can be rendered. This could be 3D models or images.
2. Enable interaction within the scene using logic bricks to script custom behaviour and determine how it is invoked (using the appropriate "sensors" such as keyboards or joysticks).
3. Create one (or more) camera to give a frustum from which to render the scene, and modify the parameters to support the environment in which the game will be displayed, such as Stereo rendering.
4. Launch the game, using the internal player or exporting a runtime to the appropriate platform.

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Category: [Game engine](#)

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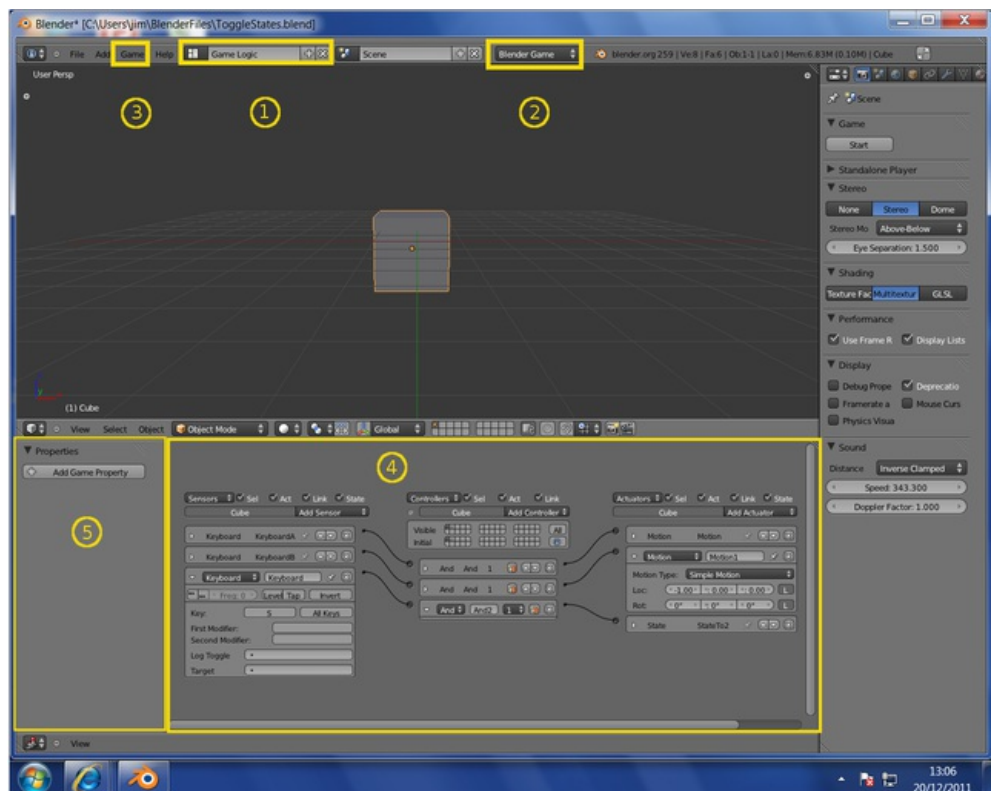
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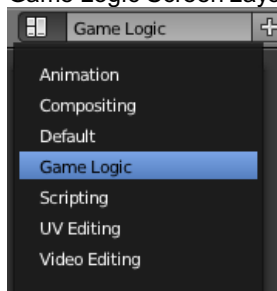
Game Logic Screen Layout

The design, construction, debugging and running of a game utilises a wide range of Blender functions. To help with the process, Blender incorporates a suggested screen layout for setting up BGE games. This includes many already-familiar panels but also a new [Logic Editor](#) panel (4) concerned solely with the BGE.

The diagram below shows this default Game Logic screen layout, together with the appropriate options for game setup/debug/running (these should be set up in the order shown).



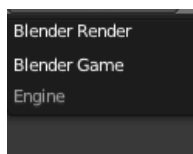
Game Logic Screen Layout



Game Logic Menu

1) Game Logic

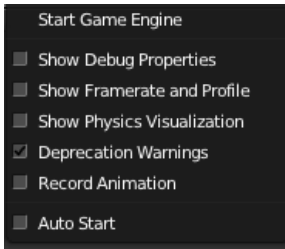
Selected from the list of screen layouts for various applications. This includes many already-familiar panels Information, 3D view, Properties but also a new Logic Editor panel concerned solely with the BGE.



Render Engine Menu

2) Blender Game

Selected from the render engine menu. This specifies that all output will be output by the real-time Blender Game Engine renderer. It also opens various other menu options such as the Game options (see below) and a range of Properties for the BGE renderer properties (see below)



Game Options

3) Game

This menu gives various options for conditions for running the Game Engine.

Note that this menu is only available when the render engine is set to Blender Game.

Start Game: Run game in Game Engine (shortcut p or ⇧ ShiftP when the mouse cursor is over the 3D View window).

Show Debug Properties: Show properties marked for debugging while game runs

Show framerate and profile :Show framerate and profiling information while game runs

Show Physics visualization: show a visualization of physics bounds and interactions

Deprecation warnings : Print warnings when using deprecated features in the python API

Record animation : Record animation to F-curves

Auto Start : Automatically start game at load time

4) Logic Editor panel

The [Logic Editor](#) is where the [logic, properties and states](#) are set up to control the behaviour of the objects in the game. (The Logic Editor panel can also be displayed by selecting Logic Editor in the Display Editor menu, or by pressing Ctrl→).

5) Properties



Two Meanings for the Same Word

Note that the name "Property" has two different uses in Blender terminology - firstly in the wider use of the Property Display Panel as described here, and secondly as the term used for specific Game Engine logic variables which are also called "properties".

The Property panel of the screen is selected as usual from the main Information menu. However note that several sections of the Property panel are changed when the render engine (2) is changed from Blender Render to Blender Game.

See following sections for details of the content of [Physics](#) Properties panels.

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Logic, Properties and States

Game Logic is the default scripting layer in the game engine. Each GameObject in the game may store a collection of logical components (Logic Bricks) which control its behavior within the scene. Logic bricks can be combined to perform user-defined actions that determine the progression of the simulation.

Logic Bricks

The main part of game logic can be set up through a graphical interface the [Logic Editor](#), and therefore does not require detailed programming knowledge. Logic is set up as blocks (or “bricks”) which represent preprogrammed functions; these can be tweaked and combined to create the game/application. There are three types of logic brick: [Sensors](#), [Controllers](#) and [Actuators](#). Sensors are primitive event listeners, which are triggered by specific events, such as a collision, a key press or mouse movement. Controllers carry out logic operations on sensor output, and trigger connected actuators when their operating conditions are met. Actuators interact with the simulation directly, and are the only components in the game which are able to do so (other than the Python controller, and other simulation components such as Physics

Properties

[Properties](#) are like variables in other programming languages. They are used to save and access data values either for the whole game (eg. scores), or for particular objects/players (e.g. names). However, in the Blender Game Engine, a property is associated with an object. Properties can be of different types, and are set up in a special area of the [Logic Editor](#).

States

Another useful feature is object [States](#). At any time while the simulation is running, the object will process any logic which belongs to the current state of the object. States can be used to define groups of behaviour - eg. an actor object may be "sleeping", "awake" or "dead", and its logic behavior may be different in each of these three states. The states of an object are set up, displayed and edited in the Controller logic bricks for the object.

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Game_Engine/Logic"

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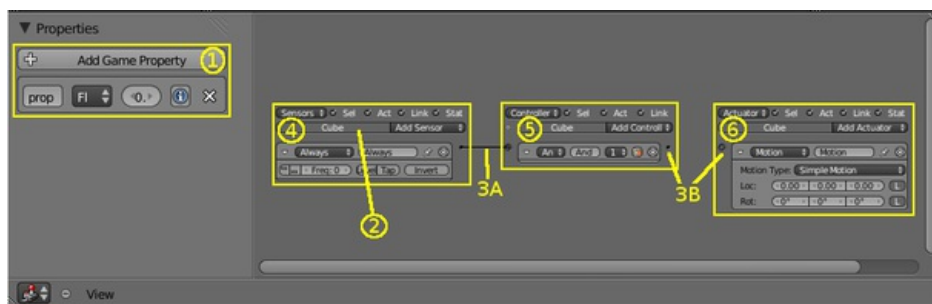
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Logic Editor

The Logic Editor provides the main method of setting up and editing the game logic for the various actors (i.e. objects) that make up the game. The logic for the objects which are currently selected in the associated 3D panel are displayed as logic bricks, which are shown as a table with three columns, showing sensors, controllers, and actuators, respectively. The links joining the logic bricks conduct the pulses between sensor-controller and controller-actuator.

To give you a better understanding of the Logic Editor panel, the image below shows a typical panel content in which the major components have been labeled. We will look at each one individually.



The different parts of the Logic Panel.


1) Game Property Area

Game properties are like variables in other programming languages. They are used to save and access data associated with an object. Several types of properties are available. Properties are declared by clicking the Add Game Property button in this area. For a more in-depth look at the content, layout and available operations in this area, see [Properties](#).

2) Object Name

This box shows the name of the object which owns the logic bricks below.

3) Links

Links (3A) indicate the direction of logical flow between objects. Link lines are drawn by LMB  dragging from one Link node (3B) to another. Links can only be drawn from Sensors to Controllers, or from Controllers to Actuators. You cannot directly link Sensors to Actuators; likewise, Actuators cannot be linked back to Sensors (however special actuator and sensor types are available to provide these connections).

Sending nodes (the black circles found on the right-hand side of Sensors and Controllers) can send to multiple Reception nodes (the white circles found on the left-hand side of Controllers and Actuators). Reception nodes can likewise receive multiple links.

Links can be created between logic bricks belonging to different objects.

To delete a link between two nodes, LMB  drag between the two nodes.

4) Sensor Area

This column contains a list of all sensors owned by the active object (and any other selected objects). New sensors for the active object are created using the "Add Sensor" button. For a more in-depth look at the content, layout and available operations in this area, see [Sensors](#).

5) Controller Area

This column contains a list of all controllers owned by the active object (and any other selected objects). New controllers for the active object are created using the "Add Controller" button, together with the creation of states for the active object. For a more in-depth look at the content, layout, and available operations in this area, see [Controllers](#).

6) Actuator Area This column contains a list of all actuators owned by the active object (and any other selected objects). New actuators for the active object are created using the "Add Actuator" button. For a more in-depth look at the content, layout, and available operations in this area, see [Actuators](#).

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Sensors

Sensors are the logic bricks that cause the logic to do anything. Sensors give an output when something happens, e.g. a trigger event such as a collision between two objects, a key pressed on the keyboard, or a timer for a timed event going off. When a sensor is triggered, a positive pulse is sent to all controllers that are linked to it.

The logic blocks for all types of sensor may be constructed and changed using the [Logic Editor](#); details of this process are given in the [Sensor Editing](#) page.

The following types of sensor are currently available:

Actuator	Detects when a particular actuator receives an activation pulse.
Always	Gives a continuous output signal at regular intervals.
Collision	Detects collisions between objects or materials.
Delay	Delays output by a specified number of logic ticks.
Joystick	Detects movement of specified joystick controls.
Keyboard	Detects keyboard input.
Message	Detects either text messages or property values
Mouse	Detects mous events.
Near	Detects objects that move to within a specific distance of themselves.
Property	Detects changes in the properties of its owner object.
Radar	Detects objects that move to within a specific distance of themselves, within an angle from an axis.
Random	Generates random pulses.
Ray	Shoots a ray in the direction of an axis and detects hits.
Touch	Detects when the object is in contact with another object.

Sensor Editing

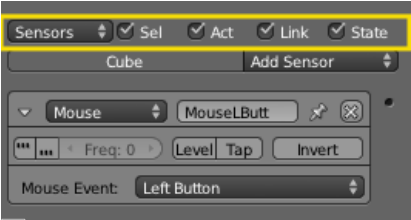


Sensor Column with Typical Sensor

Blender sensors can be set up and edited in the left-hand column of the Logic Panel. This page describes the general column controls, and also those parameters which are common to all individual sensor types.

The image shows a typical sensor column with a single example sensor. At the top of this column, the column heading includes menus and buttons to control which of all the sensors in the current Game Logic are displayed.

Column Heading



Sensor Column Heading

The column headings contain controls to set which sensors, and the level of detail given, in the sensor column. This is very useful for hiding unnecessary sensors so that the necessary ones are visible and easier to reach. Both these can be controlled individually.

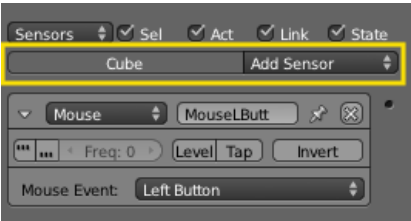
Sensors

- | | |
|--------------|--|
| Show Objects | Expands all objects. |
| Hide Objects | Collapses all objects to just a bar with their name. |
| Show Sensors | Expands all sensors. |
| Hide Sensors | Collapses all sensors to bars with their names. |

It is also possible to filter which sensors are viewed using the four heading buttons:

- | | |
|-------|--|
| Sel | Shows all sensors for selected objects. |
| Act | Shows only sensors belonging to the active object. |
| Link | Shows sensors which have a link to a controller. |
| State | Only sensors connected to a controller with active states are shown. |

Object Heading



Sensor Object Heading

In the column list, sensors are grouped by object. By default, sensors for every selected object appear in the list, but this may be modified by the column heading filters.

At the head of each displayed object sensor list, two entries appear:

Name

The name of the object.

Add Sensor

When clicked, a menu appears with the available sensor types. Selecting an entry adds a new sensor to the object. See [Sensors](#) for a list of available sensor types.

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Sensor Common Options



Common Sensor Options

All sensors have a set of common buttons, fields and menus. They are organized as follows:

Triangle button

Collapses the sensor information to a single line (toggle).

Sensor type menu

Specifies the type of the sensor.

Sensor name

The name of the sensor. This can be selected by the user. It is used to access sensors with Python; it needs to be unique among the selected objects.

X Button

Deletes the sensor.

The next line specifies the type of output pulse to be sent by the sensor. Sensors fire pulses to controllers.



True level triggering. If this is set, the controllers receive TRUE pulses as long as the sensor's state is positive. The sensor will fire TRUE pulses with the frequency of the sensor.



False level triggering. If this is set, the controllers receive FALSE pulses as long as the sensor's state is negative. The sensor will fire FALSE pulses with the frequency of the sensor.

Note about triggers

If you don't set any triggers, the sensor fires no pulse at all as long as the sensor's state does not change. When the sensor changes its state from negative to positive, the sensor fires one TRUE pulse to the controllers. When sensor changes its state from positive to negative, the sensor fires one FALSE pulse to the controllers.

In between, the controllers might still request the sensor's state, but if the controller does not get pulses (TRUE or FALSE) from any other sensor it will not be activated at all.

Freq

Despite the name, "Frequency", this parameter sets the delay between repeated pulses, measured in logic ticks. The default value is 0 and it means no delay.

Logic ticks have a frequency of 60 Hz (60 ticks per second). For example:

- setting $f=1$ means the sensor pulses once every 60th of a second. A setting of $f = 1$, effectively means a 1 to 1 ratio between ticks, 1 tick = 1 pulse.
- setting $f=30$ means the sensor pulses once after 30 ticks have elapsed. This means the pulse is emitted every half a second because there are 60 ticks per second by default.
- setting $f=60$ means the sensor pulses every 60 ticks, which means one time per second

Raising the value of f is good for saving performance by not doing things more often than necessary.

Level Button

Triggers appropriate controllers when the state changes to a new value. (For more information see [States](#)).

Tap Button

Sends a positive pulse only once even if the sensor remains true. Only one of **Tap** or **Level** can be activated.

When the **Tap** parameter is set, the sensor will fire a FALSE pulse within the next frame, even when the sensor event is still present. When the sensor's event goes away, no pulse will be fired.

If the *TRUE level triggering* is set, the TRUE/FALSE pulse pair will be repeated until the sensor's event goes away.

The *FALSE level triggering* will be ignored when the *Tap* parameter is set.

Pulses will not be inverted when the *Inv* parameter is set. But the TRUE/FALSE pulse pair will be sent when the sensor's event is not present.

Invert Button

This inverts the sensor output.

If this is set, the sensor will send FALSE pulses when the sensor should send TRUE pulses, and TRUE pulses if the sensor

should send FALSE pulses. If the *Tap* parameter is set, the sensor sends individual pulses (refer to the previous section) but TRUE/FALSE are reversed.

Note about Inv and triggers

Note that the toggle Inv inverts the level BEFORE the triggers, which means the triggers act on the signal coming out from Inv.

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Actuator sensor



Actuator sensor

The Actuator sensor detects when a particular actuator receives an activation pulse.

The Actuator sensor sends a TRUE pulse when the specified actuator is activated.

The sensor also sends a FALSE pulse when the specified actuator is deactivated.

See [Sensor Common Options](#) for common options.

Special Options:

Actuator

Name of actuator (NB This must be owned by the same object).

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Always Sensor



Always sensor

The Always sensor is used for things that need to be done every logic tick, or at every x logic tick (with non-null f), or at start-up (with Tap).

See [Sensor Common Options](#) for common options.

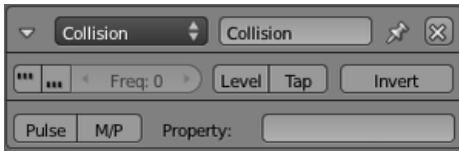
This sensor doesn't have any special options.

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Collision sensor



Collision sensor

A Collision sensor works like a Touch sensor but can also filter by property or material. Only objects with the property/material with that name will generate a positive pulse upon collision. Leave blank for collision with any object.

See [Sensor Common Options](#) for common options.

Special Options:

Pulse button

Makes it sensible to other collisions even if it is still in touch with the object that triggered the last positive pulse.

M/P button

Toggles between material and property filtering.

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Joystick sensor



Joystick sensor

The Joystick sensor triggers whenever the joystick moves. It also detects events on a range of ancilliary controls on the joystick device (hat, buttons, etc.). More than one joystick may be used (see "Index"). The exact layout of the joystick controls will depend on the make and model of joystick used.

See [Sensor Common Options](#) for common options.

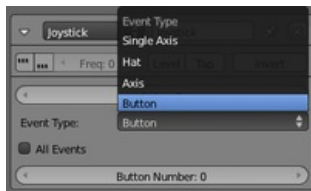
Special Options:

Index

Specifies which joystick to use.

All Events

Sensor triggers for all events on this joystick's current type



Joystick Events

Event Type

A menu to select which joystick event to use



Joystick Single Axis

Single Axis

Detect movement in a single joystick Axis.

Axis Number

- 1 = Horizontal axis (left/right)
- 2 = Vertical axis (forward/back)
- 3 = Paddle axis up/down
- 4 = Joystick axis twist left/right

Axis Threshold

Threshold at which joystick fires (Range 0 - 32768)



Joystick Hat

Hat

Detect movement of a specific hat control on the joystick.

Hat number

Specifies which hat to use (max. 2)

Hat Direction

Specifies the direction to use: up, down, left, right, up/right, up/left, down/right, down/left.



Joystick Axis

Axis

Axis Number

Specifies the axis (1 or 2)

Axis Threshold

Threshold at which joystick fires (Range 0 - 32768)

Axis Direction specifies the direction to use:

(Axis Number = 1) Joystick Left, Right, Up, Down

(Axis Number = 2) Paddle upper (Left); paddle Lower (Right); Joystick twist left (Up) Joystick twist right (Down)



Joystick Button

Button

Specify the button number to use.

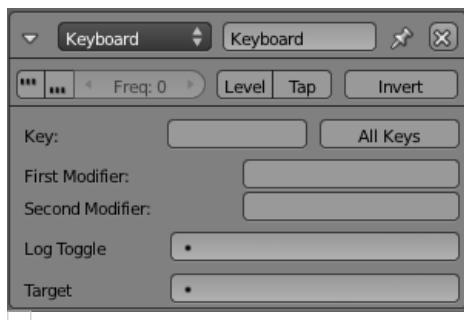
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Keyboard Sensor



Keyboard sensor

The Keyboard sensor is for detecting keyboard input. It can also save keyboard input to a [String property](#).

See [Sensor Common Options](#) for common options.

Special Options:

Key

This field detects presses on a named key. Press the button with no label and a key to assign that key to the sensor. This is the active key, which will trigger the TRUE pulse. Click the button and then click outside of the button to deassign the key.

A FALSE pulse is given when the key is released.

All keys button

Sends a TRUE pulse when any key is pressed. This is useful for custom key maps with a [Python controller](#).

First Modifier

Second Modifier

Specifies additional key(s), all of which must be held down while the active key is pressed in order for the sensor to give a TRUE pulse. These are selected in the same way as Key. This is useful if you wish to use key combinations, for example CtrlR or ⇧ ShiftAltEsc to do a specific action.

LogToggle

Assigns a Bool property which determines if the keystroke will or will not be logged in the target String. This property needs to be TRUE if you wish to log your keystrokes.

Target

The name of property to which the keystrokes are saved. This property must be of type String. Together with a Property sensor this can be used for example to enter passwords.

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Message Sensor



Message sensor

The Message sensor can be used to detect either text messages or property values. The sensor sends a positive pulse once an appropriate message is sent from anywhere in the engine. It can be set up to only send a pulse upon a message with a specific subject.

See [Sensor Common Options](#) for common options.

Special Options

Subject

Specifies the message that must be received to trigger the sensor (this can be left blank).

Note: See [Message Actuator](#) for how to send messages

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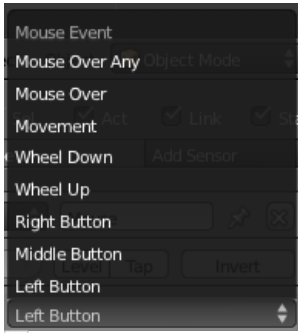
Mouse sensor



Mouse sensor

The Mouse sensor is for detecting mouse events.

See [Sensor Common Options](#) for common options.



Mouse Events

Special Options

The controller consist only of a list of types of mouse events. These are:

- Mouse over any, gives a TRUE pulse if the mouse moves over any game object.
- Mouse over, gives a TRUE pulse if the mouse moves over the owner object.
- Movement, any movement with the mouse causes a stream of TRUE pulses.
- Wheel Down, causes a stream of TRUE pulses as the scroll wheel of the mouse moves down.
- Wheel Up, causes a stream of TRUE pulses as the scroll wheel of the mouse moves up.
- Right button gives a TRUE pulse.
- Middle button gives a TRUE pulse.
- Left button gives a TRUE pulse.

A FALSE pulse is given when any of the above conditions ends.

There is no logic brick for specific mouse movement and reactions (such as first person camera), these have to be coded in python.

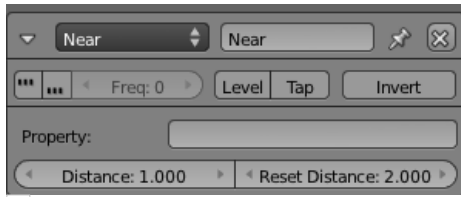
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Near sensor



Near sensor

A Near sensor detects objects that move to within a specific distance of themselves. It can filter objects with properties, like the Collision sensor.

See [Sensor Common Options](#) for common options.

Special Options

Property

This field can be used to limit the sensor to look for only those objects with this property.

Distance

The number of blender units it will detect objects within.

Reset

The distance the object needs to be to reset the sensor (send a FALSE pulse).

Notes

- 1) The Near sensor can detect objects "through" other objects (walls etc).
- 2) Objects must have "Actor" enabled to be detected.

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Property Sensor

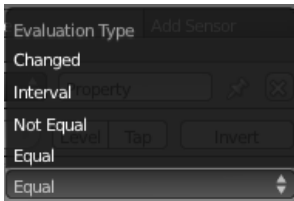


Property sensor

The Property sensor detects changes in the properties of its owner object.

See [Sensor Common Options](#) for common options.

Special Options



Property Evaluation

Evaluation Type

Specifies how the property will be evaluated against the value(s).

Changed

Sends a TRUE pulse as soon as the property value changes.

Interval

Sends a TRUE pulse when the Value of the property is between the Min and Max values of the sensor.

Not Equal

Sends a TRUE pulse when the property value differs from the Value in the sensor.

Equal

Sends a TRUE pulse when the property value matches the Value in the sensor.

Note the names of other properties can also be entered to compare properties.

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Radar Sensor



Radar sensor

The Radar sensor works much like a Near sensor, but only within an angle from an axis, forming an invisible cone with the top in the objects' center and base at a distance on an axis.

See [Sensor Common Options](#) for common options.

Special Options

Property

This field can be used to limit the sensor to look for only those objects with this property.

Notes

- 1) The Radar sensor can detect objects "through" other objects (walls etc).
- 2) Objects must have "Actor" enabled to be detected.

Axis

This menu determines the direction of the radar cone. The \pm signs is whether it is on the axis direction (+), or the opposite (-).

Angle

Determines the angle of the cone. (Range: 0.00 to 179.9 degrees).

Distance

Determines the length of the cone. (Blender units).

This sensor is useful for giving bots sight only in front of them, for example.

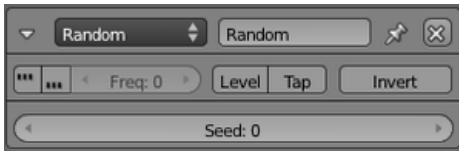
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Random sensor



Random sensor

The Random sensor generates random pulses.

See [Sensor Common Options](#) for common options.

Special Options:

Literal|Seed

This field to enter the initial seed for the random number algorithm. (Range 0-1000).

Notes -

- 1) 0 is not random, but is useful for testing and debugging purposes.
- 2) If you run several times with the same Seed, the sequence of intervals you get will be the same in each run, although the intervals will be randomly distributed.

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Ray Sensor



Ray sensor

The Ray sensor shoots a ray in the direction of an axis and sends a positive pulse once it hits something. It can be filtered to only detect objects with a given material or property.

See [Sensor Common Options](#) for common options.

Special Options: It shares a lot of buttons and fields with Radar sensor.

Property

This field can be used to limit the sensor to look for only those objects with this property.

Notes

- 1) Unless the Property field is set, the Ray sensor can detect objects "through" other objects (walls etc).
- 2) Objects must have "Actor" enabled to be detected.

Axis

This menu determines the direction of the ray. The \pm signs is whether it is on the axis direction (+), or the opposite (-).

Range

Determines the length of the ray. (Blender units).

X-Ray Mode button

Makes it x-ray, so that it sees through objects that don't have the property or material specified in the filter field.

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Touch sensor



Touch sensor

The Touch sensor sends a positive pulse when the object is in contact with another object.

See [Sensor Common Options](#) for common options.

Special Options

Material

This field is for filtering materials. Only contact with the material in this field will generate a positive pulse. Leave blank for touch with any object.

A TRUE pulse is sent on collision and the FALSE pulse is sent once the objects are no longer in contact.

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Controllers

The controllers are the bricks that collect data sent by the sensors, and also specify the state for which they operate. After performing the specified logic operations, they send out pulse signals to drive the actuators to which they are connected.

When a sensor is activated, it sends out a positive pulse, and when it is deactivated, it sends out a negative pulse. The controllers' job is to check and combine these pulses to trigger the proper response.

The logic blocks for all types of controller may be constructed and changed using the [Logic Editor](#); details of this process are given in the [Controller Editing](#) page.

Controller Types

There are eight types of controller logic brick to carry out the logic process on the input signal(s): these are described in the separate pages shown below:

- [AND](#)
- [OR](#)
- [XOR](#)
- [NAND](#)
- [NOR](#)
- [XNOR](#)
- [Expression](#)
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This table gives a quick overview of the logic operations performed by the logical controller types. The first column, input, represents the number of positive pulses sent from the connected sensors. The following columns represent each controller's response to those pulses. True means the conditions of the controller are fulfilled, and the actuators it is connected to will be activated; false means the controller's conditions are not met and nothing will happen. Please consult the individual controller pages for a more detailed description of each controller.

Note

It is assumed that more than one sensor is connected to the controller. For only one sensor, consult the "All" line.

Positive sensors	Controllers					
	AND	OR	XOR	NAND	NOR	XNOR
None	False	False	False	True	True	True
One	False	True	True	True	False	False
Multiple, not all	False	True	False	True	False	True
All	True	True	False	False	False	True

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Game_Engine/Logic/Controllers"

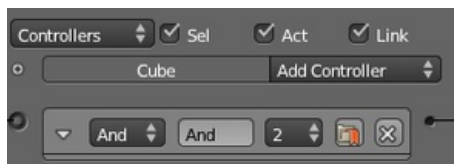
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Controller Editing

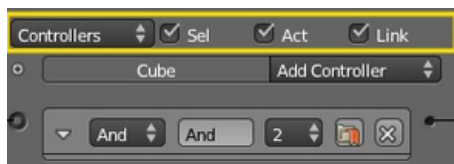


Controller Column with Typical Sensor

Blender controllers can be set up and edited in the central column of the Logic Panel. This page describes the general column controls, those parameters which are common to all individual controller types, and how different states for the objects in the logic system can be set up and edited.

The image shows a typical controller column with a single controller. At the top of this column, and for sensors and actuators, the column heading includes menus and buttons to control which of all the controllers in the current Game Logic are displayed.

Column Heading



Controller Column Headings

The column headings contain controls to set which controllers appear, and the level of detail given, in the controller column. This is very useful for hiding unnecessary controllers so that the necessary ones are visible and easier to reach. Both these can be controlled individually.

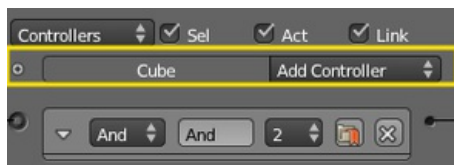
Controllers

Show Objects	Expands all objects.
Hide Objects	Collapses all objects to just a bar with their name.
Show Controllers	Expands all Controllers.
Hide Controllers	Collapses all Controllers to bars with their names.

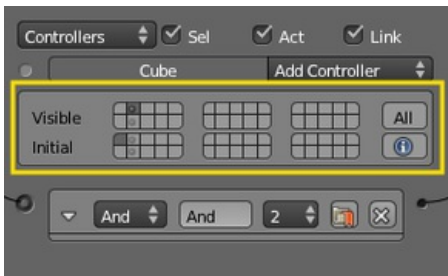
It is also possible to filter which controllers are viewed using the three heading buttons:

Sel	Shows all controllers for selected objects.
Act	Shows only controllers belonging to the active object.
Link	Shows controllers which have a link to actuators/sensors.

Object Heading



Controller Column Object Headings, Used States Button = Off



Controller Column Object Headings, Used States Button = On

In the column list, controllers are grouped by object. By default, controllers for every selected object appear in the list, but this may be modified by the column heading filters.

At the head of each displayed object controller list, three entries appear:

(Used States Button)

Shows which states are in use for the object. Detailed description of the marked panel is given in [States](#).

Name

The name of the object.

Add Controller

When clicked, a menu appears with the available controller types. Selecting an entry adds a new controller to the object. See [Controllers](#) for a list of available controller types.

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AND Controller

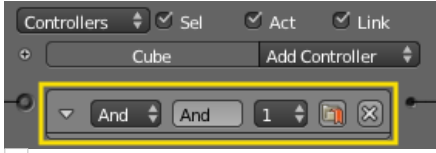
This controller gives a positive (TRUE) output when

All its inputs are TRUE, and

The object is in the designated State.

For all other conditions the controller gives a negative (FALSE) output.

Options:



AND Controller

Controller Type menu

Specifies the type of the controller.

Controller Name

The name of the controller. This can be selected by the user. It is used to access controllers with python; it needs to be unique among the selected objects.

State Index

Sets the designated state for which this controller will operate.

Preference Button

If on, this controller will operate before all other non-preference controllers (useful for start-up scripts).



Button

Deletes the sensor.

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OR Controller

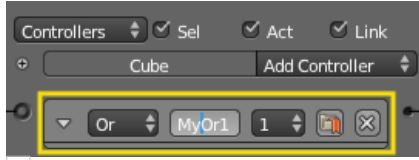
This controller gives a positive (TRUE) output when

Any one or more of its inputs are TRUE, and

The object is in the designated State.

For all other conditions the controller gives a negative (FALSE) output.

Options:



OR Controller

Controller Type menu

Specifies the type of the controller.

Controller Name

The name of the controller. This can be selected by the user. It is used to access controllers with python; it needs to be unique among the selected objects.

State Index

Sets the designated state for which this controller will operate.

Preference Button

If on, this controller will operate before all other non-preference controllers (useful for start-up scripts).



Button

Deletes the sensor.

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NAND Controller

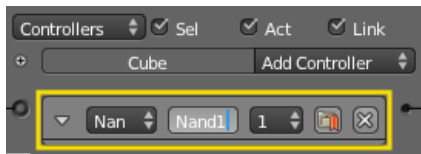
This controller **activates** all connected actuators if

- the game object is in the designated state
- at least one connected sensor triggers the controller
- at least one connected sensor evaluated False

This controller **deactivates** all connected actuators if

- the game object is in the designated state
- at least one connected sensor triggers the controller
- ALL connected sensor evaluated True

Options:



NAND Controller

Controller Type menu

Specifies the type of the controller.

Controller Name

The name of the controller. This can be selected by the user. It is used to access controllers with python; it needs to be unique among the selected objects.

State Index

Sets the designated state for which this controller will operate.

Preference Button

If enabled, this controller will operate before all other non-preference controllers (useful for start-up scripts).



Button

Deletes the sensor.

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NOR Controller

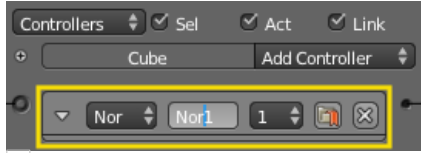
This controller gives a positive (TRUE) output when

None of its inputs are TRUE, and

The object is in the designated State.

For all other conditions the controller gives a negative (FALSE) output.

Options:



NOR Controller

Controller Type menu

Specifies the type of the controller.

Controller Name

The name of the controller. This can be selected by the user. It is used to access controllers with python; it needs to be unique among the selected objects.

State Index

Sets the designated state for which this controller will operate.

Preference Button

If on, this controller will operate before all other non-preference controllers (useful for start-up scripts).



Button

Deletes the sensor.

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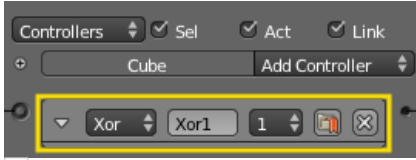
XOR Controller

This controller gives a positive (TRUE) output when

One (and only one) of its inputs are TRUE, and
The object is in the designated State.

For all other conditions the controller gives a negative (FALSE) output.

Options:



XOR Controller

Controller Type menu

Specifies the type of the controller.

Controller Name

The name of the controller. This can be selected by the user. It is used to access controllers with python; it needs to be unique among the selected objects.

State Index

Sets the designated state for which this controller will operate.

Preference Button

If on, this controller will operate before all other non-preference controllers (useful for start-up scripts).



Button

Deletes the sensor.

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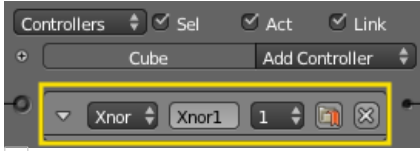
XNOR Controller

This controller gives a positive (TRUE) output when

One (and only one) of its inputs are FALSE, and
The object is in the designated State.

For all other conditions the controller gives a negative (FALSE) output.

Options:



XNOR Controller

Controller Type menu

Specifies the type of the controller.

Controller Name

The name of the controller. This can be selected by the user. It is used to access controllers with python; it needs to be unique among the selected objects.

State Index

Sets the designated state for which this controller will operate.

Preference Button

If on, this controller will operate before all other non-preference controllers (useful for start-up scripts).



Button

Deletes the sensor.

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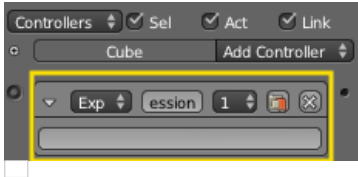
Expression Controller

This controller evaluates a user written expression, and gives a positive (TRUE) output when

The result of the expression is TRUE, and

The object is in the designated State.

For all other conditions the controller gives a negative (FALSE) output.



Expression Controller

Expression

The expression, which is written in the box, can consist of variables, constants and operators. These must follow the rules laid out below.

Variables

You can use:

- **sensors names**,
- **properties**: assign a game property to an object and use it in a controller expression.

These cannot contain blank spaces.

Operations

Mathematical operations

Operators: *, /, +, -

Returns: a number

Examples: 3 + 2, 35 / 5

Logical operations

- Comparison operators: <, >, >=, <=, ==, !=
- Booleans operators: AND, OR, NOT

Returns: True or False.

Examples: 3 > 2 (True), 1 AND 0 (False)

Conditional statement (if)

Use:

```
if( expression, pulse_if_expression_is_true, pulse_if_expression_is_false )
```

If the controller evaluates **expression** to True:

- if **pulse_if_expression_is_true** is True, the controller sends a positive pulse to the connected actuators.
- if **pulse_if_expression_is_true** is False, the controller sends a negative pulse to the connected actuators.

If the controller evaluates **expression** to False:

- if **pulse_if_expression_is_false** is True, the controller sends a positive pulse to the connected actuators.
- if **pulse_if_expression_is_false** is False, the controller sends a negative pulse to the connected actuators.

Examples

Given the object has a property **coins** equal to 30:

```
coins > 20
```


returns True (the controller sends a positive pulse to the connected actuators).

Given the object has:

- a sensor called **Key_Inserted** equal to True,
- a property named **Fuel** equal to False,

`Key_Inserted AND Fuel`

returns False (the controller sends a negative pulse to the connected actuators).

This is the same as doing:

```
if (Key_Inserted AND Fuel, True, False)
```

Instead, you could do:

```
if (Key_Inserted AND Fuel, False, True)
```

to return a positive pulse when **Key_Inserted AND Fuel** returns False.

You can also do:

```
if ((Key_Inserted AND Fuel) OR (coins > 20), True, False)
```

This expression returns True, hence in this case the controller sends a positive pulse to the connected actuators.

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Python Controller

[To be constructed]

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Actuators

Actuators perform actions, such as move, create objects, play a sound. The actuators initiate their functions when they get a positive pulse from one (or more) of their controllers.

The logic blocks for all types of actuator may be constructed and changed using the [Logic Editor](#); details of this process are given in the [Actuator Editing](#) page.

The following types of actuator are currently available:

Action	Handles armature actions. This is only visible if an armature is selected.
Camera	Has options to follow objects smoothly, primarily for camera objects, but any object can use this.
Constraint	Constraints are used to limit object's locations, distance, or rotation. These are useful for controlling the physics of the object in game.
Edit Object	Edits the object's mesh, adds objects, or destroys them. It can also change the mesh of an object (and soon also recreate the collision mesh).
Filter 2D	Filters for special effects like sepia colours or blur.
Game	Handles the entire game and can do things as restart, quit, load, and save.
Message	Sends messages, which can be received by other objects to activate them.
Motion	Sets object into motion and/or rotation. There are different options, from "teleporting" to physically push rotate objects.
Parent	Can set a parent to the object, or unparent it.
Property	Manipulates the object's properties, like assigning, adding, or copying.
Random	Creates random values which can be stored in properties.
Scene	Manage the scenes in your .blend file. These can be used as levels or for UI and background.
Sound	Used to play sounds in the game.
State	Changes states of the object.
Steering	Provides pathfinding options for the object.
Visibility	Changes visibility of the object.

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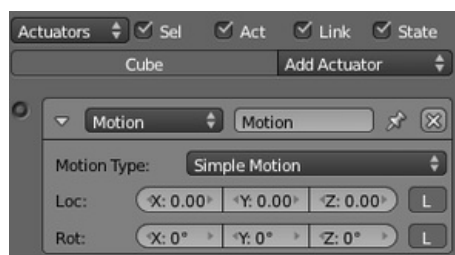
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Actuator Editing

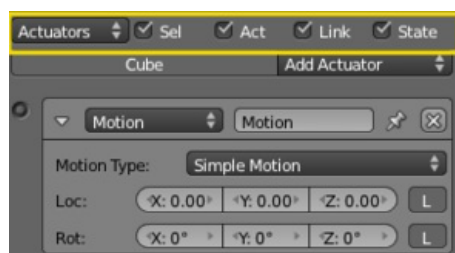


Actuator Column with Typical Actuator

Blender actuators can be set up and edited in the right-hand column of the Logic Panel. This page describes the general column controls, and also those parameters which are common to all individual actuator types.

The image shows a typical actuator column with a single example actuator. At the top of this column, the column heading includes menus and buttons to control which of all the actuators in the current Game Logic are displayed.

Column Heading



Actuator Column Heading

The column headings contain controls to set which actuators, and the level of detail given, in the actuator column. This is very useful for hiding unnecessary actuators so that the necessary ones are visible and easier to reach. Both these can be controlled individually.

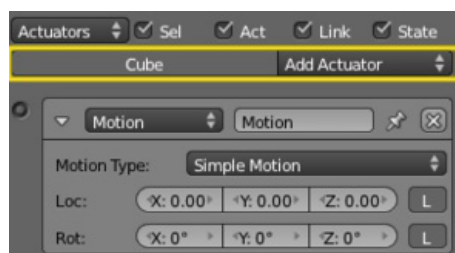
Actuators

Show Objects	Expands all objects.
Hide Objects	Collapses all objects to just a bar with their name.
Show Actuators	Expands all actuators.
Hide Actuators	Collapses all actuators to bars with their names.

It is also possible to filter which actuators are viewed using the four heading buttons:

Sel	Shows all actuators for selected objects.
Act	Shows only actuators belonging to the active object.
Link	Shows actuators which have a link to a controller.
State	Only actuators connected to a controller with active states are shown.

Object Heading



Actuator Object Heading

In the column list, actuators are grouped by object. By default, actuators for every selected object appear in the list, but this may be modified by the column heading filters.

At the head of each displayed object sensor list, two entries appear:

Name

The name of the object.

Add

When clicked, a menu appears with the available actuator types. Selecting an entry adds a new actuator to the object. See [Actuators](#) for list of available actuator types.

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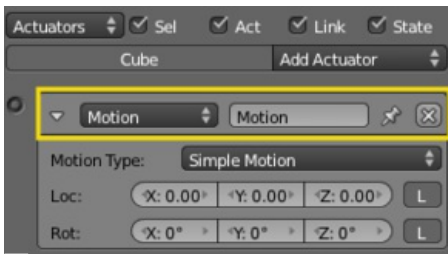
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Actuator Common Options



Common Actuator Options

All actuators have a set of common buttons, fields and menus. They are organized as follows:

Triangle button

Collapses the sensor information to a single line (toggle).

Actuator type menu

Specifies the type of the sensor.

Actuator name

The name of the actuator. This can be selected by the user. It is used to access actuators with python; it needs to be unique among the selected objects.



Button

Deletes the actuator.

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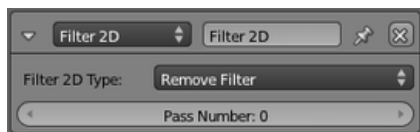
- This page has been accessed 1,171 times.

Filter 2D Actuator

2D Filters are image filtering actuators, that apply on final render of objects.

Filter 2D Type

Select the type of 2D Filter required.



Edit Object actuator

Custom Filter
Invert
Sepia
Gray Scale
Prewitt
Sobel
Laplacian
Erosion
Dilation
Sharpen
Blur
Motion Blur
Remove Filter
Disable Filter
Enable Filter

Only one parameter is required for all filters

Pass Number

The pass number for which this filter is to be used.

Details of the filters are given in the descriptive text below.

Motion Blur

Motion Blur is a 2D Filter that needs previous rendering information to produce motion effect on objects. Below you can see Motion Blur filter in Blender window, along with its logic bricks:



2D Filters: Motion Blur.



2D Filters: Game Logic.

To enable this filter:

1. Add appropriate Sensor(s) and Controller(s).
2. Add a 2D Filter Actuator.
3. Select Motion Blur in the drop-down list.
4. Set Motion Blur Value (Factor).

And for disabling this filter:

1. Add appropriate Sensor(s) and Controller(s).
2. Add a 2D Filter Actuator.

3. Select Motion Blur.
4. Toggle Enable button to go to disabled mode.

You can enable Motion Blur filter using a Python controller:

```
from bge import render
render.enableMotionBlur(0.85)
```

And disable it:

```
from bge import render
render.disableMotionBlur()
```

Note

Your graphic hardware and OpenGL driver must support accumulation buffer (`glAccum` function).

Built-In 2D Filters

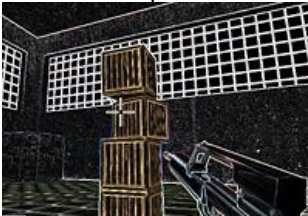
All 2D filters you can see in 2D Filter actuator have the same architecture, all built-in filters use fragment shader to produce final render view, so your hardware must support shaders.



2D Filters: Motion Blur.



2D Filters: Sepia.



2D Filters: Sobel.

Blur, Sharpen, Dilation, Erosion, Laplacian, Sobel, Prewitt, Gray Scale, Sepia and Invert are built-in filters. These filters can be set to be available in some passes.

To use a filter you should:

1. Create appropriate sensor(s) and controller(s).
2. Create a 2D Filter actuator.
3. Select your filter, for example Blur.
4. Set the pass number that the filter will be applied.

To remove a filter on a specific pass:

1. Create appropriate sensor(s) and controller(s).
2. Create a 2D Filter actuator.
3. Select Remove Filter.
4. Set the pass number you want to remove the filter from it.

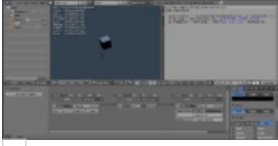
To disable a filter on a specific pass:

1. Create appropriate sensor(s) and controller(s).
2. Create a 2D Filter actuator.
3. Select Disable Filter.
4. Set the pass number you want to disable the filter on it.

To enable a filter on a specific pass:

1. Create appropriate sensor(s) and controller(s)
2. Create a 2D Filter actuator.
3. Select Enable Filter.
4. Set the pass number you want to enable the filter on it.

Custom Filters



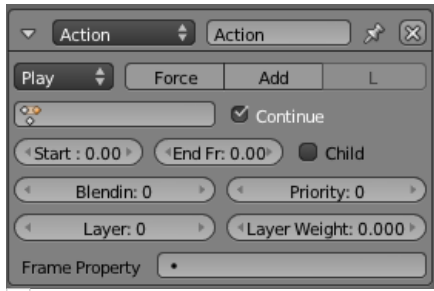
2D Filters: Custom Filter.

Custom filters give you the ability to define your own 2D filter using GLSL. Its usage is the same as built-in filters, but you must select Custom Filter in 2D Filter actuator, then write shader program into the Text Editor, and then place shader script name on actuator.

Blue Sepia Example:

```
uniform sampler2D bgl_RenderedTexture;  
void main(void)  
{  
    vec4 texcolor = texture2D(bgl_RenderedTexture, gl_TexCoord[0].st);  
    float gray = dot(texcolor.rgb, vec3(0.299, 0.587, 0.114));  
    gl_FragColor = vec4(gray * vec3(0.8, 1.0, 1.2), texcolor.a);  
}
```

Action Actuator



Action Actuator

Actuates armature actions, and sets the playback method. The Action actuator is only visible when an armature is selected, because actions are stored in the armature.

See [Actuator Common Options](#) for common options.

Special Options:

Action Playback Type

Play -

Play ipo once from start to end when a TRUE pulse is received.

Ping Pong

Flipper

Play ipo once from start to end when a TRUE pulse is received. (Plays backwards when a FALSE pulse is received).

Loop End

Play ipo continuously from end to start when a TRUE pulse is received.

Loop Start

Play ipo continuously from start to end when a TRUE pulse is received.

Property

Action

Select the action to use

Continue

Restore last frame when switching on/off, otherwise play from the start each time

Start Frame

Set the start frame of the action

End Frame

Set the end frame of the action

Child Button

Blendin

Number of frames of motion blending

Priority

Execution priority - lower numbers will override actions with higher numbers. With 2 or more actions at once, the overriding channels must be lower in the stack

Frame Property

Assign the action's current frame number to this property

Property

Use this property to define the Action position. Only for Property playback type.

Layer

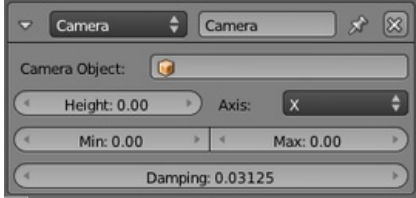
Layer Weight

Camera Actuator

Makes the camera follow or track an object.

See [Actuator Common Options](#) for common options.

Special Options:



Camera Actuator

Camera Object

Name of the Game Object that the camera follows/tracks.

Height

Height the camera tries to stay above the Game Object's object center

Axis

Axis in which the Camera follows (X or Y)

Min

Minimum distance for the camera to follow the Game Object

Max

Maximum distance for the camera to follow the Game Object

Damping

Strength of the constraint that drives the camera behind the target. Range: 0 to 10. The higher the parameter, the quicker the camera will adjust to be inside the constrained range (of min, max and height).

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Constraints Actuator

Adds a constraint to the location, orientation

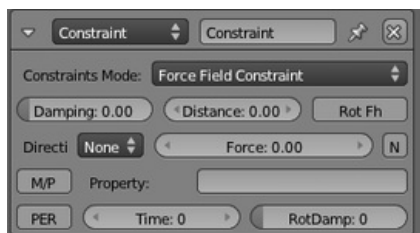
See [Actuator Common Options](#) for common options.

Special Options:

Constraint Mode

Menu specifying type of constraint required.

- Force Field Constraint
- Orientation Constraint
- Distance Constraint
- Location Constraint



Constraint actuator - Force Field

Force Field Constraint

Create a force field buffer zone along one axis of the object.

Damping

Damping factor of the Fh spring force (Range 0.0 - 1.0)

Distance

Height of Fh area

Rot Fh

Make game object axis parallel to the normal of trigger object.

Direction

Axis in which to create force field (can be + or -, or None)

Force

N

When on, use a horizontal spring force on slopes

M/P

Trigger on another Object will be either Material (M) or Property (P)

Property

Property/Material that triggers the Force Field constraint (blank for ALL Properties/Materials)

Per

Persistence button

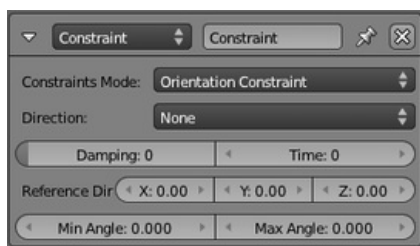
When on, force field constraint always looks at Property/Material; when off, turns itself off if it can't find the Property/Material.

Time

Number of frames for which constraint remains active

RotDamp

Damping factor for rotation



Constraint Actuator - Orientation

Orientation Constraint

Constrain the specified axis in the Game to a specified direction in the World axis.

Direction

Game axis to be modified (X, Y, Z or none)

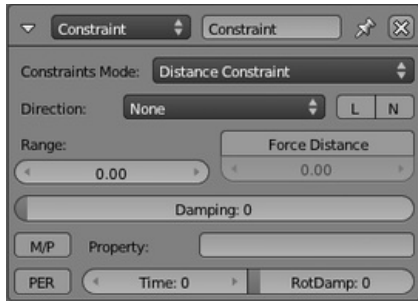
Damping
Delay (frames) of the constraint response (0 - 100)

Time
Time (frames) for the constraint to remain active (0 - 100)

ReferenceDir
Reference direction (global coordinates) for the specified game axis.

MinAngle
Minimum angle for the axis modification;

MaxAngle
Maximum angle for the axis modification;



Constraint actuator - Distance

Distance Constraint

Maintain the distance the Game Object has to be from a surface

Direction
Axis Direction (X, Y, Z, -X, -Y, -Z, or None)

L
If on, use local axis (otherwise use World axis)

N
If on, orient the Game Object axis with the mesh normal.

Range
Maximum length of ray used to check for Material/Property on another game object (0 - 2000 Blender Units)

Force Distance
•Distance to be maintained between object and the Material/Property that triggers the Distance Constraint(-2000 to +2000 Blender Units).

Damping
Delay (frames) of the constraint response (0 - 100)

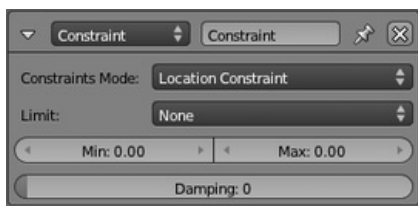
M/P
Trigger on another Object will be either Material (M) or Property (P)

Property
Property/Material that triggers the Force Field constraint (blank for ALL Properties/Materials)

Per
Persistence button: When on, force field constraint always looks at Property/Material; when off, turns itself off if it can't find the Property/Material.

Time
Number of frames for which constraint remains active

RotDamp
Damping factor for rotation



Constraint actuator - Location

Location Constraint

Limit the position of the Game Object within one World Axis direction. To limit movement within an area or volume, use two or three constraints.

Limit
Axis in which to apply limits (LocX, LocY, LocZ or none)

Min

Minimum limit in specified axis (Blender Units)

Max

Maximum limit in specified axis (Blender Units)

Damping

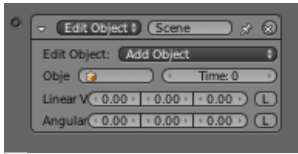
Delay (frames) of the constraint response (0 - 100)

Edit Object Actuator

The Edit Object actuator allows the user to edit settings of objects in game

See [Actuator Common Options](#) for common options.

Special Options:

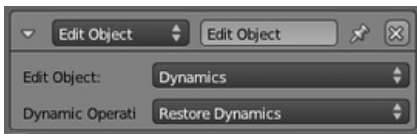


Edit Object actuator

Edit Object

Menu of options for Edit Object actuator

- Dynamics
- Track To
- Replace Mesh
- End Object
- Add Object



Edit Object actuator - Dynamics

Dynamics

Provides a menu of Dynamic Operations to set up dynamics options for object.

Set Mass

Enables the user to set the mass of the current object for Physics (Range 0 - 10,000).

Disable Rigid Body

Disables the Rigid Body state of the object - disables collision.

Enable Rigid Body

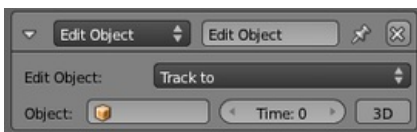
Disables the Rigid Body state of the object - enables collision.

Suspend Dynamics

Suspends the object dynamics (object velocity).

Restore Dynamics

Resumes the object dynamics (object velocity).



Edit Object actuator - Track to

Track To

Makes the object “look at” another object, in 2D or 3D. The Y-axis is considered the front of the object.

Object

Object to follow.

Time

No. of frames it will take to turn towards the target object (Range 0-2000).

3D Button(toggle).

Enable 2D (X,Y) or 3D (X,Y,Z) tracking.



Edit Object actuator - Replace Mesh

Replace Mesh

Replace mesh with another. Both the mesh and/or its physics can be replaced, together or independently.

Mesh

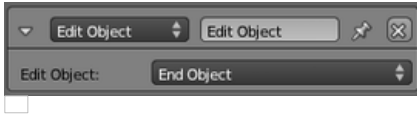
name of mesh to replace the current mesh.

Gfx Button

replace visible mesh.

Phys Button

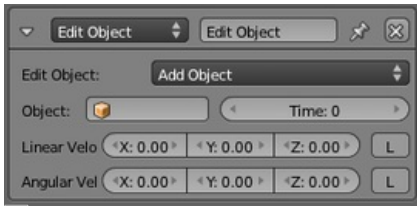
replace physics mesh (not compound shapes)



Edit Object actuator - End Object

End Object

Destroy the current object (Note, debug properties will display error Zombie Object in console)



Edit Object actuator - Add Object

Add Object

Adds an object at the centre of the current object. The object that is added needs to be on another, hidden, layer.

Object

The name of the object that is going to be added.;;Time: the time (in frames) the object stays alive before it disappears. Zero makes it stay forever.

Linear Velocity

Linear Velocity, works like in the motion actuator but on the created object instead of the object itself. Useful for shooting objects, create them with an initial speed.

Angular Velocity

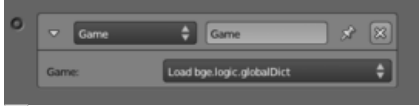
Angular velocity, works like in the motion actuator but on the created object instead of the object itself.

Game Actuator

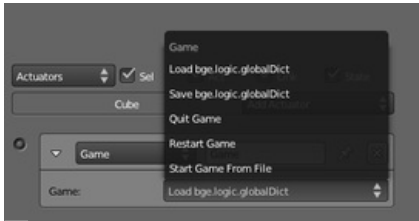
The Game actuator allows the user to perform Game-specific functions, such as Restart Game, Quit Game and Load Game.

See [Actuator Common Options](#) for common options.

Special Options:



Game actuator



Game

Game

Load bge.logic.globalDict

Load bge.logic.globalDict from .bgeconf.

Save bge.logic.globalDict

Save bge.logic.globalDict to .bgeconf.

Quit Game

Once the actuator is activated, the blenderplayer exits the runtime.

Restart Game

Once the actuator is activated, the blenderplayer restarts the game (reloads from file).

Start Game From File

Once the actuator is activated, the blenderplayer starts the .blend file from the path specified.

File

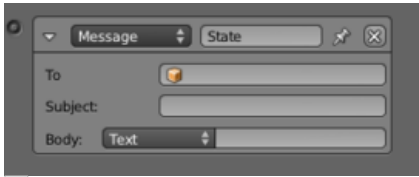
Path to the .blend file to load.

Notes

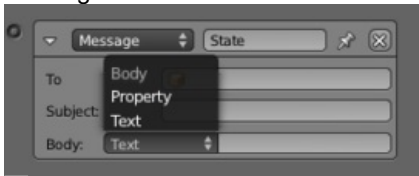
If you use the keyboard sensor as a hook for the Esc key, in the event that the quit game actuator fails, such as an error in a python file, the game will be unable to close. Data may be recovered from quit.blend File » Recover Last Session

Message Actuator

The Message actuator allows the user to send data across a scene, and between scenes themselves.



Message actuator



Message actuator Options

See [Actuator Common Options](#) for common options.

Special Options:

To

Object to broadcast to. Leave blank if broadcast to all (or sending to another scene).

Subject

Subject of message. Useful if sending certain types of message, such as "end-game", to a message sensor listening for "end game"->AND->Quit Game actuator

Body

Body of message sent (only read by Python*).

Text

User specified text in body.

Property

User specified property.

Usage Notes

You can use the Message Actuator to send data, such as scores to other objects, or even across scenes! (alternatively use `bge.logic.globalDict`).

Motion Actuator

The Motion actuator sets an object into motion and/or rotation. There are two modes of operation, simple or servo in which the object can either teleport, rotate or dynamically move. Also, simple mode operation depends on the type of Physics setting for the Object.

See [Actuator Common Options](#) for common options.

Special Options:

Motion Type

Determines type of motion

Simple Motion

applies different kinds of motions directly

Servo Control

sets a target speed and also how quickly it reaches that speed.



Object collisions

Simple motion can cause an object to go through another object since it never passes the any of the coordinates between the start and end. This can be avoided using Servo Control, which is activated when the Physics setting for the object(s) is set to Dynamic/Rigid Body/Soft Body.

Simple Motion



Motion actuator for Simple Motion

Loc

The object jumps the number of blender units entered, in each of the three axes, each time a pulse is received.

Rot

The object rotates by the specified amount, in each of the three axes, each time a pulse is received. One revolution is represented by the value 7.2 (i.e. 0.02 for one degree).

L

Coordinates specified are Global (gray) or Local (White).



Servo Control

To make Servo Control work, it is necessary to turn on Dynamic in the Physics window, and to make the object an Actor.

Servo Control



Motion actuator for Servo Control

Servo control is a powerful way to achieve motion in way which mimics the movement of objects in the physical world. It consists in a servo controller that adjusts the force on the object in order to achieve a given speed. Uses the Proportional - Integral - Derivative (PID) equations of motion See Ref..

Reference Ob

Specifies the object which the actuator owner uses as a reference for movement, for moving platforms for example. If empty it will use world reference.

Linear V

The target linear velocity, in each of the three axes, which the object will try and achieve.

L

Coordinates specified are Global (gray) or Local (White).

X, Y, Z

Sets maximum and minimum limits for the force applied to the object. If disabled (i.e. X,Y or Z buttons are gray) the force applied is unlimited.

Proportional Coefficient

Set the Proportional Coefficient. This controls the reaction to differences between the actual and target linear velocity.

Integral Coefficient

Set the Integral Coefficient. This controls the reaction to the sum of errors so far in this move.

Derivative Coefficient

Set the Derivative Coefficient. This controls the reaction

Parent Actuator

Enables you to change the parent relationships of the current object.

See [Actuator Common Options](#) for common options.

Special Options:

Scene

Menu for parenting operation required.



Parent Actuator

Set Parent

Make this object to be current object's parent

Parent Object

Name of parent object

Compound'

Add this object shape to the parent shape (only if the parent shape is already compound)

Ghost'

Make this object ghost while parented

Remove Parent

Remove all parents of current object

Parent Object

Name of parent object

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Game_Engine/Logic/Actuators/Parent"

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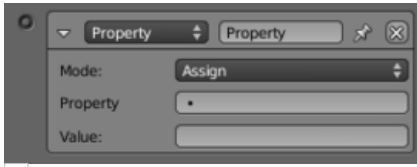
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Property Actuator

Using the Property actuator you can change the value of a given property once the actuator itself is activated.

See [Actuator Common Options](#) for common options.

Special Options:



Property actuator

Mode

Assign

the Property target property will become equal to the set Value once the actuator is activated

Add

adds Value to the value of the property Property once the actuator is activated (enter a negative value to decrease). For Bool, a value other than 0 (also negative) is counted as True.

Copy

copies a property from another object to a property of the actuator owner once the actuator is activated.

Toggle

switches 0 to 1 and any other number than 0 to 0 once the actuator is activated. Useful for on/off switches.

Property

The target property that this actuator will change

Value

The value to be used to change the property

Example

You have a character, it has a property called "hp" (hit points) to determine when he has taken enough damage to die. hp is an int with the start value of 100.

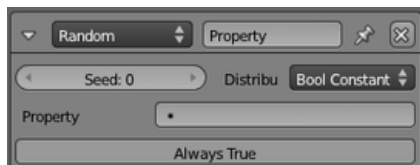
You set up two Collision sensors, one for enemy bullets, and one for picking up more health. The first one is connected (through an AND controller) to an Add Property actuator with the property hp and the value -10. Every time the player is hit by an enemy bullet he loses 10 hp. The other sensor is connected (through an AND controller) to an other Add Property actuator, this one with the value 50. So every time the player collides with a health item the hp increases by 50. Next you set up a Property sensor for an interval, greater than 100. This is connected (through an AND controller) to an Assign Property actuator which is set to 100. So if the players hp increases over 100 it is set to 100.

Random Actuator

Sets a random value into a property of the object

See [Actuator Common Options](#) for common options.

Special Options:



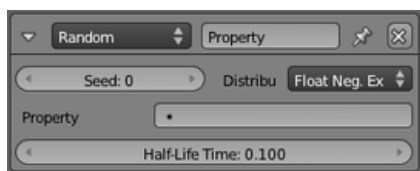
Camera Actuator

Seed

Starting seed for random generator (range 1 - 1000)

Distribution

Menu of distributions from which to select the random value. The default entry of Boolean Constant gives either True or False, which is useful for test purposes.



Float Neg. Exp.

Float Neg. Exp.

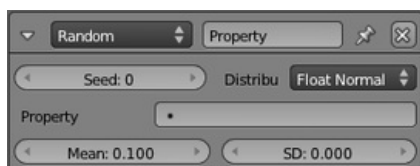
Values drop off exponentially with the specified half-life time.

Property

Float property to receive value

Half-Life Time

Half-life time (Range 0.00 -10000.00)



Float Normal

Float normal

Random numbers from a normal distribution.

Property

Float property to receive value

Mean

Mean of normal distribution (Range -10000.00 to +10000.00)

SD

Standard deviation of normal distribution (Range 0.00 to +10000.00)



Float Uniform

Float uniform

Random values selected uniformly between maximum and minimum.

Property

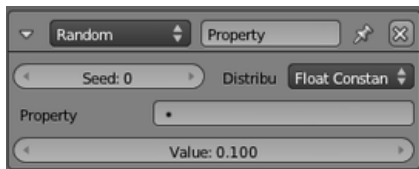
Float property to receive value

Min

Minimum value (Range -10000.00 to +10000.00)

Max

Maximum value (Range -10000.00 to +10000.00)



Float Constant

Float constant

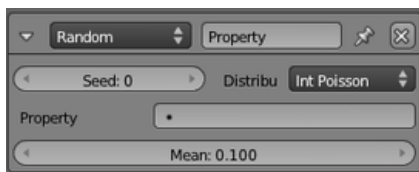
Returns a constant value.

Property

Float property to receive value

Value

Value (Range 0.00 to +1.00)



Random Integer Poisson

Int Poisson

Random numbers from a Poisson distribution.

Property

Integer property to receive value

Mean

Mean of Poisson distribution (Range 0.01 to +100.00)



Random Integer Uniform

Int uniform

Random values selected uniformly between maximum and minimum.

Property

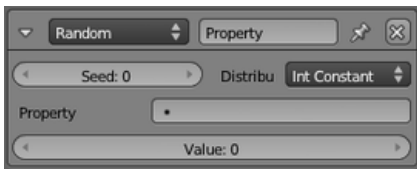
Integer property to receive value

Min

Minimum value (Range -1000 to +1000)

Max

Maximum value (Range -1000 to +1000)



Random Integer Constant

Int constant

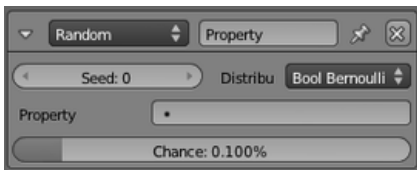
Returns a constant value.

Property

Integer property to receive value

Value

Value (Range 0.00 to +1.00)



Random Bool Bernoulli

Bool Bernoulli

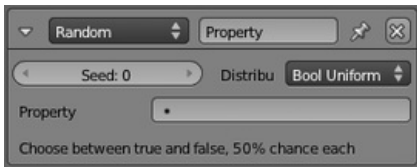
Returns a random distribution with specified ratio of TRUE pulses.

Property

Boolean property to receive value

Chance

Proportion of TRUE responses required.



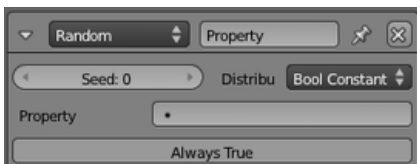
Random Bool Uniform

Bool uniform

A 50/50 chance of obtaining True/False.

Property

Boolean property to receive value



Random Bool Constant

Bool constant

Returns a constant value.

Property

Boolean property to receive value

Value

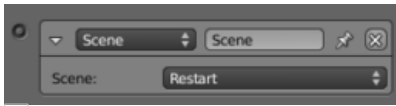
Value (True or False)

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Game_Engine/Logic/Actuators/Random"
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Scene Actuator

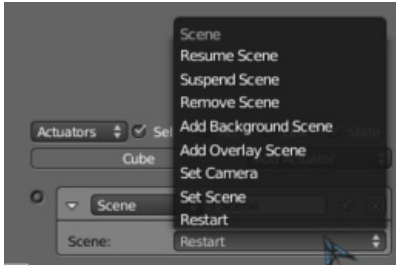


Scene actuator

The Scene actuator manages the scenes in your .blend file, these can be used as levels or for UI and background.

See [Actuator Common Options](#) for common options.

Special Options: The actuator has eight modes:



Scene actuator options

Restart

Restarts the current scene, everything in the scene is reset

Set Scene

Changes scene to selected one

Set Camera

Changes which camera is used

Add OverlayScene

This adds an other scene, and draws it on top of the current scene. It is good for interfacing: keeping the health bar, ammo meter, speed meter in an overlay scene makes them always visible.

Add BackgroundScene

This is the opposite of an overlay scene, it is drawn behind the current scene

Remove Scene

Removes a scene.

Suspend Scene

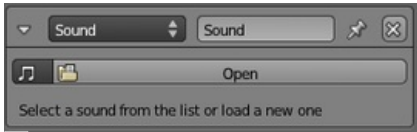
Pauses a scene

Resume Scene

Resumes a paused scene.

Sound Actuator

Select a sound file from the list or make a new one.



Sound Actuator

See [Actuator Common Options](#) for common options.

Special Options:

Music File title

Select music file from the list presented.

Retrieved from "http://wiki.blender.org/index.php/Doc:2.6/Manual/Game_Engine/Logic/Actuators/Sound"
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State Actuator

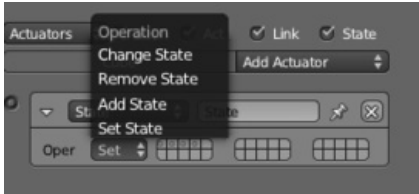
The State actuator allows the user to create complex logic, whilst retaining a clear user interface. It does this by having different states, and performing operations upon them

See [Actuator Common Options](#) for common options.

Special Options:



State actuator



State actuator options

Operation

Menu to select the state operation required.

- Change State
Change from the current state to the state specified.
- Remove State
Removes the specified states from the active states (deactivates them).
- Add State
Adds the specified states to the active states (activates them).
- Set State
Moves from the current state to the state specified, deactivating other added states.

Usage Notes

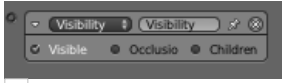
With the state actuator, you can create tiers of logic, without the need for hundreds of properties. Use it well, and you benefit greatly, but often problems may be circumvented by python.

Steering Actuator

Under Construction (7 July 2012)

Visibility Actuator

The Visibility actuator allows the user to change the visibility of objects during runtime.



Visibility actuator

See [Actuator Common Options](#) for common options.

Special Options:

Visible

Toggle checkbox to toggle visibility

Occlusion

Toggle checkbox to toggle occlusion. Must be initialised from the Physics tab.

Children

Toggle checkbox to toggle recursive setting - will set visibility / occlusion state to all child objects, children of children (recursively)

Usage Notes

Using the visibility actuator will save on Rasterizer usage, however not Physics, and so is limited in terms of Level of Detail (LOD). For LOD look at replace mesh, but be aware that the logic required can negate the effect of the LOD.

Properties

Properties are the game logic equivalent to variables. They are stored with the object, and can be used to represent things about them such as ammo, health, name, and so on.

Property Types

There are five types of properties:

Timer	Starts at the property value and counts upwards as long as the object exists. It can for example be used if you want to know how long time it takes the player to complete a level.
Float	Uses decimal numbers as values, can range from -10000.000 to 10000.000. It is useful for precision values.
Integer	Uses integers (whole numbers) as values, between -10000 and 10000. Useful for counting things such as ammunition, where decimals are unnecessary.
String	Takes text as value. Can store 128 characters.
Boolean	Boolean variable, has two values: true or false. This is useful for things that have only two modes, like a light switch.

Using Properties

Properties can be set up and initialised in the Properties panel of the Logic Editor - see the [Property Editing](#) page for details. When a game is running, values of properties are set, manipulated, and evaluated using the [Property Sensor](#) and the [Property Actuator](#).

Property Editing

Logic Properties are created and edited using the panel on the left of the Logic Editor Panel. The top menu provides a list of the available property types.



Property Panel

Add Property button

This button adds a new property to the list, default is a Float property named “prop”, followed by a number if there already is one with this name.

Name field

Where you give your property its name, this is how you are going to access it through python or expressions. The way to do so in python is by dictionary style lookup (`GameObject["propname"]`). The name is case sensitive.

Type menu

This menu determines which type of property it is ([see below](#)).

Value field

Sets the initial value of the property.

I information button

Display property value in debug information. If debugging is turned on, the value of the property is given in the top left-hand corner of the screen while the game is run. To turn debugging on, tick Show Debug Properties in the Game menu. All properties with debugging activated will then be presented with their object name, property name and value during gameplay. This is useful if you suspect something with your properties is causing problems.

X


Delete property.

States

In the BGE, an object can have different "states". At any time while the game is playing, the current state of the object defines its behavior. For instance, a character in your game may have states representing awake, sleeping or dead. At any moment their behaviour in response to a loud bang will be dependant on their current state; they may crouch down (awake); wake up (asleep) or do nothing (dead).

How States Operate

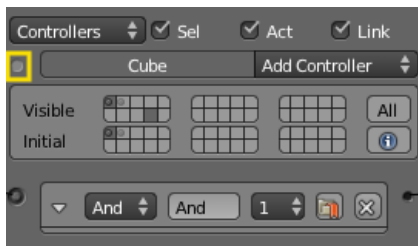
States are set up and used through controllers: note that only controllers, not actuators and sensors, are directly controlled by the state system. Each object has a number of states (up to 30; default = 1), and can only be in one state at any particular time. A controller must always specify the state for which it will operate - it will only give an output pulse if a) its logic conditions are met, and b) the object is currently in the specified State. States are set up and edited in the object's Controller settings (for details see below).

 State settings are automatic in simple games. By default, the number of states for each object is 1, and all controllers are set to use State 1. So, if a game does not need multiple states, everything will work without explicitly setting states - you do not need to bother about states at all.

{{{2}}}

One of the actuators, the State actuator, can set or unset the object's State bits, and so allow the object's reaction to a sensor signal to depend on its current state. So, in the above example, the actor will have a number of controllers connected to the "loud bang" sensor, for each of the "awake", "asleep" or "dead" states. These will operate different actuators depending on the current state of the actor, and some of these actuators may switch the actor's state under appropriate conditions.

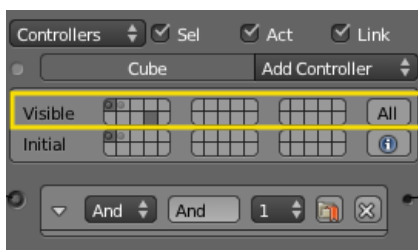
Editing States



State Panel Button

States are set up and edited using the Controller (center) column of the Game Logic Panel. To see the State panel, click on the State Panel Button shown. The panel shows two areas for each of the 30 available states; these show Visible states, and Initial states (see below). Setting up the State system for a game is performed by choosing the appropriate state for each controller in the object's logic.

The display of an object's state logic, and other housekeeping, is carried out using the State Panel for the object, which is switched on and off using the button shown. The panel is divided into two halves, Visible and Initial.



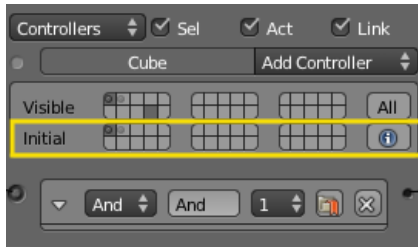
State Panel Visible

Visible States

In the Visible area, each of the 30 available states is represented by a light-gray square. This panel shows what logic is visible for the logic brick displayed for the object. At the right is the All button; if clicked, then all the object's logic bricks are displayed (this is a toggle), and all State Panel squares are light-gray. Otherwise, individual states can be clicked to make their logic visible. (Note that you can click more than one square). Clicking the square again unselects the state.

States for the object that are in use (i.e. the object has controllers which operate in that state) have dots in them, and squares are dark-gray if these controllers are shown in the Game Logic display. The display of their connected sensors and actuators can also be

controlled if the State buttons at the head of their columns are ticked.



State Panel Initial

Initial State

In the Initial area, each of the 30 available states is again represented by a light-gray square. One of these states may be clicked as the state in which the object starts when the game is run.

At the right is the I (Information) button; if clicked, and the (Game) Show Debug Properties menu entry is clicked, the current state of the object is shown in the top left-hand corner of the display while the game is running.

□

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Camera

The Game Engine camera is in many ways similar to the Camera in the normal Blender Render system, and is created, parameterized and manipulated in similar ways. However because of its use as a real-time device, the Game Engine camera has a number of additional features - it may be used as not only as a static camera, but also as a moving device with its default characteristics (ie. with its own programmed moves), or it may track another object in the game. Furthermore, any game object may be used as a camera; the view is taken from the object's origin point. Lastly, it may be given special capabilities such as Stereo vision, Dome visualisation etc. which have special relevance to game technology.

When you start the Game Engine, the initial camera view is taken from the latest 3D View. This may be either a selected camera

object or the default camera (see below). Thus to start the game with a particular camera, you must select the camera and press 0 NumPad before starting the Game Engine.



To avoid camera distortion, always zoom the view in until the camera object fills the entire viewport

{{{2}}}

Default camera

The default camera view is taken from the latest 3D viewport view, at a distance equivalent to the viewer. This means that, if the normal 3D view is active, the scene does not change when the Game Engine is started.

Camera Object

The Camera object in the Game Engine follows much the same structure as the conventional Blender camera - see [Camera](#) for details of how to set up, manipulate and select a camera. The following sections show some of the special facilities available in BGE cameras.

Parent Camera to Object

The camera will follow the object. First select the camera and then select the object. Next CtrlP → Make Parent.

Note that if your object has any rotations then the camera will also have those rotations. To avoid this use "Parent to Vertex" (see below).

Parent to Vertex

The easiest way to accomplish this is to select your object and ⇐ Tab to Edit mode. Now select the vertex and ⇐ Tab back to Object mode.

Next, without any objects selected, select the camera and, holding the ⇧ Shift key, select the object. ⇐ Tab into Edit mode, and CtrlP and choose Make vertex parent.

Now the camera will follow the object and it will maintain its rotation, while the object rotates.

Object as a Camera

Any object may also become a camera with whatever properties are set for the object.

To make an object the camera, in Object mode select the object and press Ctrl0 NumPad on the numpad.

To reverse it, just select the camera and Ctrl0 NumPad again.

Camera lens shift

In the blender interface, there is an option to shift the camera view on the x/y plane of the view. It is comparable to lens shift in video projectors, that usually shift the image up along the Y axis (so for ex. when you put the beamer on a table, it does not project half of the image on the table.)

Unfortunately, this parameter is not taken in account by the game engine.

To manipulate the projection, we can then modify directly the camera projection matrix in python.

```
import bge
scene = bge.logic.getCurrentScene()
cam = scene.active_camera
# get projection matrix
camatrix = cam.projection_matrix
#modifying the camera projection matrix by modifying the x and y terms of the 3rd row to obtain a shift of the rendered area
camatrix[2][0] = 2*shiftx
camatrix[2][1] = 2*shifty
cam.projection_matrix = camatrix
```

shiftx and shifty are here in field of view unit, so for ex. for shifting the view up half a screen, shifty is set to 0.5.

Note that a camera's projection_matrix attribute may not be set until after initialization scripts are executed and running this code immediately after the game starts will mess up the projection matrix.

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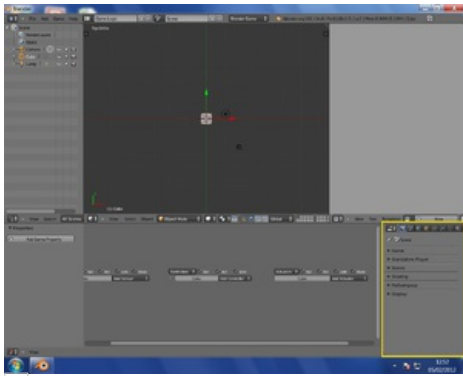
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Camera Editing



Camera Properties

The camera (or cameras) used in a Blender game have a wide-ranging effect on the way in which the game is rendered and displayed. Mostly this is controlled using the Properties panel of the camera(s) used in the game.



Render Engine

Make sure that the render engine is set to Blender Game when attempting to set these controls - otherwise this description will not tally with what you see!

In the Camera Properties area, there are six panels available, as shown. Each can be expanded or contracted using the usual triangle button. The features in each panel will be described in detail below.

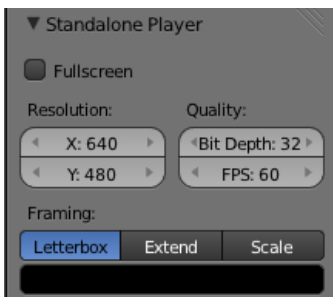
Game



Game Panel

Start button - Start the Game Engine.

Standalone Player



Standalone Panel

This panel provides information for the Standalone Game Player which allows games to be run without Blender. See [Standalone Player](#) for further details.

Fullscreen -

- Off - opens standalone game as a new window.
- On - opens standalone game in full screen.

Resolution

X

Sets the X size of the viewport for full-screen display.

Y

Sets the Y size of the viewport for full-screen display.

Quality

Bit Depth

Number of bits used to represent color of each pixel in full-screen display.

FPS

Number of frames per second of full-screen display.

Framing

Shows how the display is to be fitted in to the viewport.

Letterbox

Show the entire viewport in the display window, and fill the remainder with the "bar" color.

Extend

Show the whole display in the viewport, and fill the remainder with bars.

Scale

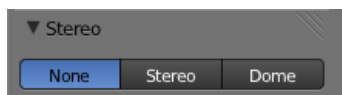
Scale the display in X and Y to exactly fill the entire viewport.

Bar Color

Select a color to use as the color of bars around the viewport (default black).

To use this, select a color mode (RGB, HSV or Hex), then use the color slider and color wheel to choose a bar color.

Stereo



Stereo Panel

Select a stereo mode that will be used to capture stereo images of the game (and also, by implication, that stereo displays will use to render images in the standalone player).

None

Render single images with no stereo.

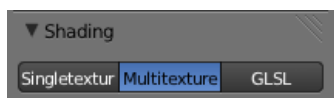
Stereo

Render dual images for stereo viewing using appropriate equipment. See [Stereo Camera](#) for full details of available options.

Dome

Provides facilities for an immersive dome environment in which to view the game. See [Dome Camera](#) for full details of available options.

Shading



Shading Panel

Specifies the shading mode to be used in rendering the game. The shading facilities available in Blender for use in [Materials](#) and [Textures](#) are essentially the same in the Blender Game Engine. However the constraints of real-time display mean that only some of the facilities are available.

Single Texture

Use single texture facilities.

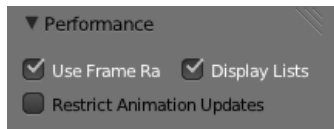
Multitexture

Use Multitexture shading.

GLSL

Use GLSL shading. GLSL should be used whenever possible for real-time image rendering.

Performance



Performance Panel

Use Frame Rate

Respect the frame rate rather than rendering as many frames as possible.

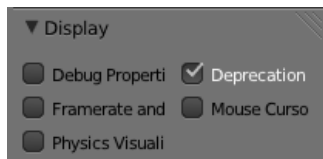
Display Lists

Use display lists to speed up rendering by keeping geometry on the GPU.

Restrict Animation Updates

Restrict number of animation updates to the animation FPS (this is better for performance but can cause issues with smooth playback).

Display



Display Panel

Gives various display options when running the Game Engine. under the .

Debug Properties

Show properties marked for debugging while game runs. Note that debug properties to be shown must be requested at source (eg. i-button in state tables). Only available when game is run within Blender - not in standalone player version.

Framerate and Profile

Show framerate and profiling information while game runs. Only available when game is run within Blender - not in standalone player version.

Physics Visualization

Show physics bounds and interactions while game runs (available in both Blender and standalone versions).

Deprecation Warnings

Print warnings when using deprecated features in the python API. Only available when game is run within Blender - not in standalone player version.

Mouse Cursor

Show mouse cursor while game runs (available in both Blender and standalone versions).

Stereo Camera

Stereo Cameras allow you to generate images that appear three dimensional when wearing special glasses. This is achieved by rendering two separate images from cameras that are a small distance apart from each other, simulating how our own eyes see. When viewing a stereo image, one eye is limited to seeing one of the images, and the other eye sees the second image. Our brain is able to merge these together, making it appear that we are looking at a 3d object rather than a flat image. See [Stereoscopy](#) for more information on different stereoscopic viewing methods.

Stereo Settings

Stereo Mode

Set the type of stereo camera to use. They are detailed below.

Eye Separation

This value is extremely important. It determines how far apart the two image-capturing cameras are, and thus how "deep" the scene appears. Too small a value and the image appears flat; too high a value can result in headaches and eye strain. The ideal value mimics the separation of the viewer's two eyes.

Stereo Modes

Specifies the way in which the left-eye image and the right-eye image pixels are put together during rendering. This must be selected according to the type of apparatus available to display the appropriate images to the viewer's eyes.

Quad Buffer

Above-Below

Frames are displayed one after the other, so providing the two images in two frames, one above the other.

Interlaced

One frame is displayed with the two images displayed on alternate lines of the display.

Anaglyph

One frame is displayed with both images displayed as red-blue anaglyph.

Side by Side

Lines are displayed one after the other, so providing the two images in two frames side by side.

Vinterlaced

One frame is displayed with both images displayed on alternate columns of the display. This works with some 'autostereo displays'.

Dome Camera

This feature allows artists to visualize their interactive projects within an immersive dome environment. In order to make it an extensible tool, we are supporting Fulldome, Truncated domes (front and rear), Planetariums and domes with spherical mirrors.

The Dome camera uses a multipass texture algorithm as developed by Paul Bourke and was implemented by Dalai Felinto with sponsorship from **SAT** - Society for Arts and Technology within the **SAT Metalab** immersion research program.^[1] Briefly, that involves rendering the scene 4 times and placing the subsequent images onto a mesh designed especially such that the result, when viewed with an orthographic camera, is a fisheye projection.

Note

Remember to use Blender in **fullscreen mode** to get the maximum out of your projector.

To accomplish that launch Blender with the command-line argument -W. Also to get away of the top menu on Blender try to join all windows (buttons, 3dview, text, ...) in a single one. Otherwise if you only maximize it (Ctrl+Up) you can't get the whole screen free to run your game (the top bar menu takes about 20 pixels).

Dome Camera Settings

Dome Type

This menu allow you to select which type of dome camera to use. They are outlined below, along with the settings that appear below.

- [Fisheye Dome](#)
- [Front-Truncated Dome](#)
- [Rear-Truncated Dome](#)
- [Cube Map](#)
- [Full Spherical Panoramic](#)

Available camera settings change depending on the selected Dome Type:

Resolution

Sets the resolution of the Buffer. Decreasing this value increases speed, but decreases quality

Tessellation

4 is the default. This is the tessellation level of the mesh. (Not available in Cube Map mode).

Angle

Sets the field of view of the dome in degrees, from 90 to 250. (Available in Fisheye and Truncated modes).

Tilt

Set the camera rotation in the horizontal axis. Available in Fisheye and Truncated modes).

[Warp Data](#)

Use a custom warp mesh data file.

Fisheye Mode

An Orthogonal Fisheye view from 90° to 250° degrees.

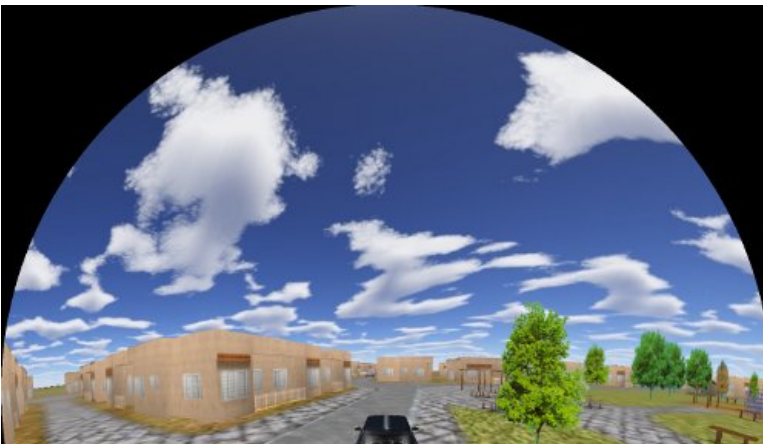
- From 90° to 180° we are using 4 renders.
- From 181° to 250° we are using 5 renders.



Front-Truncated Dome Mode

Designed for truncated domes, this mode aligns the fisheye image with the top of the window while touching the sides.

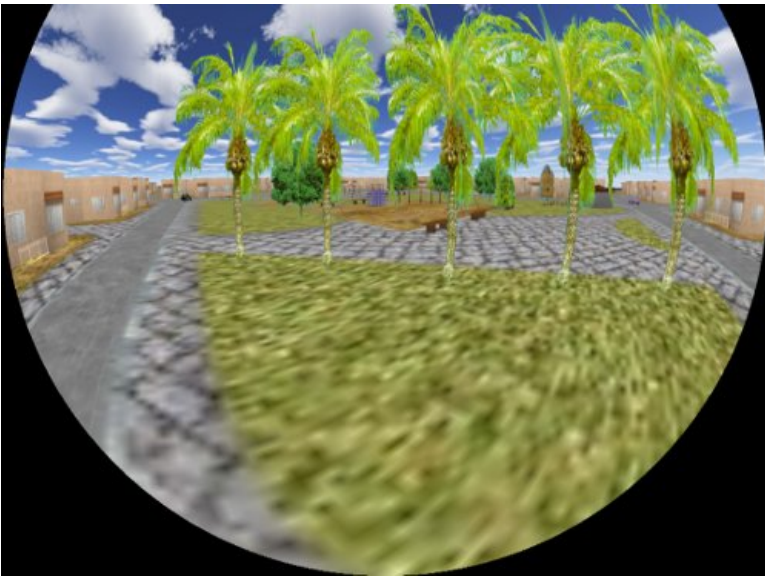
- The Field of view goes from 90° to 250° degrees.
- From 90° to 180° we are using 4 renders.
- From 181° to 250° we are using 5 renders.



Rear-Truncated Dome Mode

Designed for truncated domes, this mode aligns the fisheye image with the bottom of the window while touching the sides.

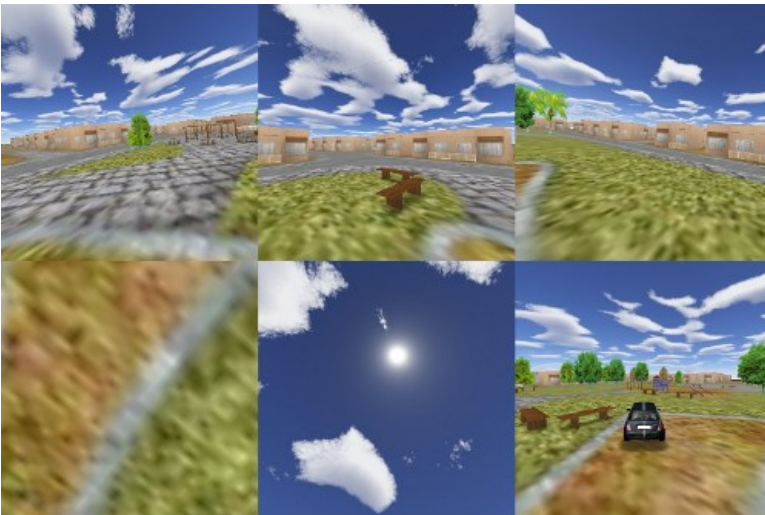
- The Field of view goes from 90° to 250° degrees.
- From 90° to 180° we are using 4 renders.
- From 181° to 250° we are using 5 renders.



Cube Map Mode

Cube Map mode can be used for pre-generate animated images for CubeMaps.

- We are using 6 renders for that. The order of the images follows Blender internal EnvMap file format:
 - first line: right, back, left
 - second line: bottom, top, front



Spherical Panoramic

A full spherical panoramic mode.

- We are using 6 cameras here.
- The bottom and top start to get precision with **Definition** set to 5 or more.



Warp Data Mesh

Many projection environments require images that are not simple perspective projections that are the norm for flat screen displays. Examples include geometry correction for cylindrical displays and some new methods of projecting into planetarium domes or upright domes intended for VR.

For more information on the mesh format see [Paul Bourke's article](#).



In order to produce that images, we are using a specific file format.

File template::

```
mode
width height
n0_x n0_y n0_u n0_v n0_i
n1_x n1_y n1_u n1_v n1_i
n2_x n2_y n2_u n2_v n2_i
n3_x n3_y n3_u n3_v n3_i
(...)
```

First line is the image type the mesh is support to be applied to: **2 = rectangular**, **1 = radial**Next line has the mesh dimensions in pixelsRest of the lines are the nodes of the mesh.

Each line is compund of **x y u v i**(x,y) are the normalised screen coordinates(u,v) texture coordinatesi a multiplicative intensity factor
x varies from -screen aspect to screen aspecty varies from -1 to 1u and v vary from 0 to 1i ranges from 0 to 1, if negative don't draw that mesh node

- You need to create the file and add it to the Text Editor in order to select it as your Warp Mesh data file.
- Open the Text Editor (Window Types/Text Editor).
- Open your mesh data file(ie. myDome.data) in the text editor (Text/Open or Alt O on keyboard).
- Go to Game Framing Settings (Window Types/Buttons Window/Scene Page or F10 on keyboard)
- Enable Dome Mode.
- Type filename in Warp Data field(ie. myDome.data).

To create your own Warp Meshes an interactive tool called meshmapper is available as part of [Paul Bourke's Warpplayer](#) software package(requires full version).

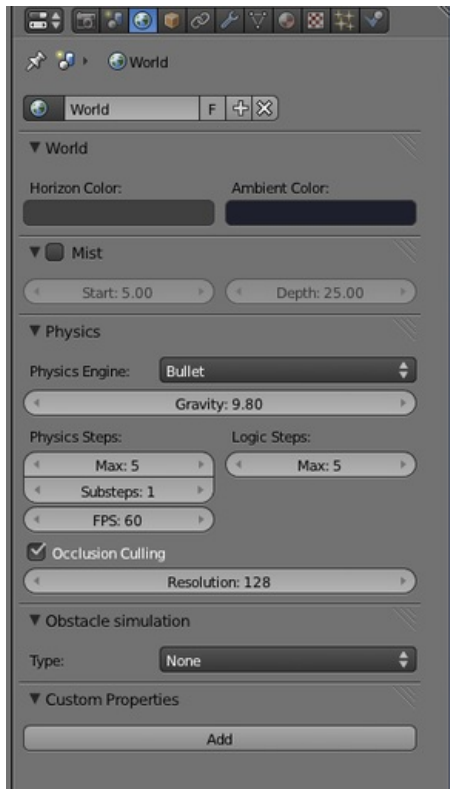
Example files

[Spherical Mirror Dome 4x3](#), [Truncated Dome 4x3](#), [Sample Fullscreen File 4x3](#), [Sample Fullbuffer File 4x3](#).

Note

Important: the viewport is calculated using the ratio of canvas width by canvas height. Therefore different screen sizes will require different warp mesh files. Also in order to get the correct ratio of your projector you need to use Blender in Fullscreen mode.

World



BGE World Panel (fully expanded)

World settings enable you to set some basic effects which affect all scenes throughout your game, so giving it a feeling of unity and continuity. These include ambient light, depth effects (mist) and global physics settings. These effects are a limited subset of the more extensive range of effects available with the Blender renderer (see [Doc:2.6/Manual/World|World](#))

💡 While world settings offer a simple way of adding effects to a scene, [compositing nodes](#) are often preferred, though more complex to master, for the additional control and options they offer. For example, filtering the Z value (distance from camera) or normals (direction of surfaces) through compositing nodes can further increase the depth and spacial clarity of a scene.

{{{2}}}

World

These two color settings allow you to set some general lighting effects for your game.

Horizon Color

The RGB color at the horizon ; i.e. the color and intensity of any areas in the scene which are not filled explicitly.

Ambient Color

Ambient light mimics an overall background illumination obtained from diffusing surfaces (see [Ambient Light](#), [Exposure](#) and [Ambient Occlusion](#)). Its general color and intensity are set by these controls.

Mist

Mist can greatly enhance the illusion of depth in your rendering. To create mist, Blender makes objects farther away more transparent (decreasing their Alpha value) so that they mix more of the background color with the object color. With Mist enabled, the further the object is away from the camera the less it's alpha value will be. For full details, see [Mist](#).

Mist check box

Toggles mist on and off

Start

The starting distance of the mist effect. No misting will take place for objects closer than this distance.

Depth

The depth at which the opacity of objects falls to zero.

Game Physics

The Game Physics located in the World panel determine the type of physical rules that govern the game engine scene, and the gravity value to be used. Based on the physics engine selected, in physics simulations in the game engine, Blender will automatically move Actors in the downward (-Z) direction. After you arrange the actors and they move as you wish, you can then bake this computed motion into fixed lpo curves (see [Logic actors](#) for more info).

Physics Engine

Set the type of physics engine to use.

Bullet

The default physics engine, in active development. It handles movement and collision detection. The things that collide transfer momentum to the collided object.

None

No physics in use. Things are not affected by gravity and can fly about in a virtual space. Objects in motion stay in that motion.

Gravity

The gravitational acceleration, in units of meters per squared second ($m \cdot s^{-2}$), of this world. Each object that is an actor has a mass and size slider (see [Object Physics](#) section).

In conjunction with the frame rate (see [Render](#) section), Blender uses this info to calculate how fast the object should accelerate downward.

Physics Steps

Max

Sets the maximum number of physics steps per game frame if graphics slow down the game. higher value allows physics to keep up with realtime.

Substeps

Sets the number of simulation substeps per physics timestep. Higher value give better physics precision.

FPS

Set the nominal number of game frames per second. Physics fixed timestep = $1/fps$, independently of actual frame rate.

Logic Steps Max

Sets the maximum number of logic frame per game frame if graphics slows down the game, higher value allows better synchronization with physics.

Occlusion Culling

Use optimized Bullet DBVT for view frustum and occlusion culling.

Resolution

The size of the occlusion buffer in pixel, use higher value for better precision (slower).

Obstacle Simulation

Simulation used for obstacle avoidance in the Game Engine, based on the RVO (Reciprocal Velocity Obstacles) principle. The aim is to prevent one or more actors colliding with obstacles. Reference: User:Nicks/Gsoc2010/Docs

Type

RVO (cells)

RVO (rays)

None

- blender.org
- code.blender.org

Doc:2.6/Manual/Game Engine/Physics

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Blender 2.6

- **Blender 2.6**
- [Blender 2.4](#)

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Blender Physics

Blender includes advanced physics simulation in the form of the Bullet Physics Engine ([BulletPhysics.org](https://bulletphysics.org)). Most of your work will involve setting the right properties on the objects in your scene---then you can sit back and let the engine take over. The physics

simulation can be used for [Games](#), but also for [Animation](#).

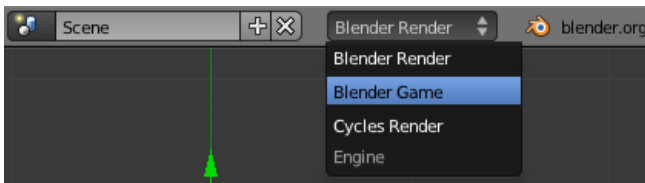
The Blender Game Engine (BGE) is based on Rigid-Body Physics, which differs significantly from the complementary set of tools available in the form of [Soft Body Physics Simulations](#). Though the BGE does have a Soft Body type, it is not nearly as nuanced as the non-BGE Soft Body. The inverse is even more true: it is difficult to get the non-BGE physics to resemble anything like a stiff shape. Rigid Body Physics does not have, as an effect or a cause, any mesh deformations. For a discussion on how to partially overcome this, see: [Mesh Deformations](#).

Getting Started

If you have never worked with the BGE, you might want to spend 10-15 minutes by doing the [Introductory Tutorial](#). After that is an interactive example, [Frijoles](#).

The rudiments are:

- Press P while your mouse is hovering in a 3D View to start.
- Hit Esc to stop.



Switching to the Blender Game Engine.

- Switch to the "Blender Game" engine so your Properties Editor will have the right options.



Properties Buttons

- Observe the differences between "Blender Game" and "Blender Render" after clicking the various Properties buttons: Render, Scene, World, Materials, Particles, and, most importantly, Physics.
- Begin changing properties to affect your simulations.
- Take a step deeper with [Logic Bricks](#) for total control, to include Python scripting.

Types

The five general-purpose types are:

Type	Collision	Movement	Rotation	Deformation	Example Use
No Collision					An on-screen display.
Static	✓				A brick wall.
Dynamic	✓	✓			A character in a side-scroller.
Rigid Body	✓	✓	✓		Most moving objects.
Soft Body	✓	✓	✓	✓	A waving flag.

Additional special-purpose types:

- [Occluder](#) - Prevents calculation of rendered objects (not their physics, though!).
- [Sensor](#) - Detects presence without restituting collisions.
- [Navigation Mesh](#) - To make pathfinding paths. Useful for Artificial Intelligence.

World Options

The global Physics Engine settings can be found in the [World Properties](#), which include the Gravity constant and some important engine performance tweaks.

Constraints

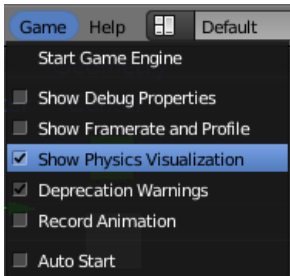
It is imperative to understand that the Blender Constraints generally don't work inside the BGE. This means interesting effects such as Copy Rotation are unavailable directly.

Your options include:

- [Parenting](#) - But not Vertex Parenting.

- [Rigid Body Joint](#) - This is the one Constraint that you can set up through the UI that works in the BGE. It has several options, and can be very powerful - see ITS page for a detailed description and demo .blend. Don't forget that you can loop through objects using `bpy` instead of clicking thousands of times to set up chains of these Constraints.
- Rigid Body Joints on the Fly - You can add/remove them after the BGE starts by using `bge.constraints.createConstraint()`. This can be good either to simply automate their setup, or to truly make them dynamic. A simple demo can be viewed in: [BGE-Physics-DynamicallyCreateConstraint.blend](#)
- [Python Controllers](#) - As always, in the BGE, you can get the most power when you drop into Python and start toying with the settings directly. For instance, the Copy Rotation mentioned above is not hard -- All you have to do is something to the effect of `own.worldOrientation = bge.logic.getCurrentScene().objects['TheTargetObject'].worldOrientation`

Visualizing Physics



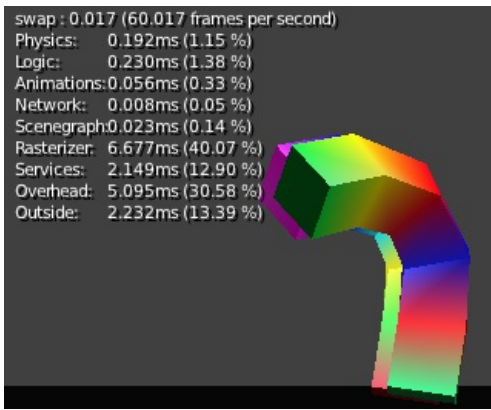
Go to Game » Show Physics Visualization to show lines representing various attributes of the Bullet representation of your objects. Note that these might be easier to see when you turn on Wireframe Mode (Z) before you press P. Also note that you can see how the Bullet triangulation is working (it busts all your Quads to Tris at run-time, but the BGE meshes are still quads at run-time).

- **RGB/XYZ Widget** - Representing the object's Local Orientation and Origin.
- **Green** - "sleeping meshes" that are not moving, saving calculations until an external event "wakes" it.
- **White** - White lines represent active bounding meshes that are undergoing physics calculations, until such calculations are so small that the object is put to rest. This is how you can see the effects of the Collision Bounds.
 - **Thick, or Many White Lines** - A compound collision mesh/meshes.
- **Violet** - Bounding meshes for Soft bodies.
- **Red** - The Bounding Box, the outer boundary of object. It is always aligned with global X Y and Z, and is used to optimize calculations. Also represents meshes that have been forced into "no sleep" status.
- **Yellow** - Normals.
- **Black** - When in wireframe, this is your mesh's visual appearance.

If you want finer-grained control over the display options, you can add this as a Python Controller and uncomment whichever pieces you want to see:

```
import bge
debugs = (
    #bge.constraints.DBG_DRAWWIREFRAME, # Draw wireframe in debug.
    bge.constraints.DBG_DRAWAABB, # Draw Axis Aligned Bounding Box in debug.
    #bge.constraints.DBG_DRAWFREETURETEXT, # Draw features text in debug.
    #bge.constraints.DBG_DRAWCONTACTPOINTS, # Draw contact points in debug.
    #bge.constraints.DBG_NOHELPTTEXT, # Debug without help text.
    #bge.constraints.DBG_DRAWTEXT, # Draw text in debug.
    #bge.constraints.DBG_PROFILETIMINGS, # Draw profile timings in debug.
    #bge.constraints.DBG_ENABLESATCOMPARISION, # Enable sat comparision in debug.
    #bge.constraints.DBG_DISABLEBULLETLCP, # Disable Bullet LCP.
    #bge.constraints.DBG_ENABLECCD, # Enable Continous Collision Detection in debug.
    #bge.constraints.DBG_DRAWCONSTRAINTS, # Draw constraints in debug.
    #bge.constraints.DBG_DRAWCONSTRAINTLIMITS, # Draw constraint limits in debug.
    #bge.constraints.DBG_FASTWIREFRAME, # Draw a fast wireframe in debug.
    #bge.constraints.POINTTOPOINT_CONSTRAINT,
    #bge.constraints.LINEHINGE_CONSTRAINT,
    #bge.constraints.ANGULAR_CONSTRAINT,
    #bge.constraints.CONETWIST_CONSTRAINT,
    #bge.constraints.VEHICLE_CONSTRAINT,
)
for d in debugs:
    bge.constraints.setDebugMode(d)
```

Show Framerate and Profile



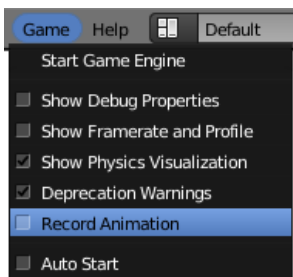
A shot of [Manual-BGE-Physics-DancingSticks.blend](#) with Game » Show Framerate and Profile enabled

If you enable Game » Show Framerate and Profile, it will put some statistics in the upper-left area of the game window.

These can be very informative, but also a bit cryptic. Moguri has elaborated on their meanings, for us: <http://mogurijn.wordpress.com/2012/01/03/bge-profile-stats-and-what-they-mean/>

Recording to Keyframes

Beyond gaming, sometimes you wish to render a complex scene that involves collisions, multiple forces, friction between multiple bodies, and air drag—but you don't want to try to manually animate each. Happily, you can count on the Blender game engine to do it for you.

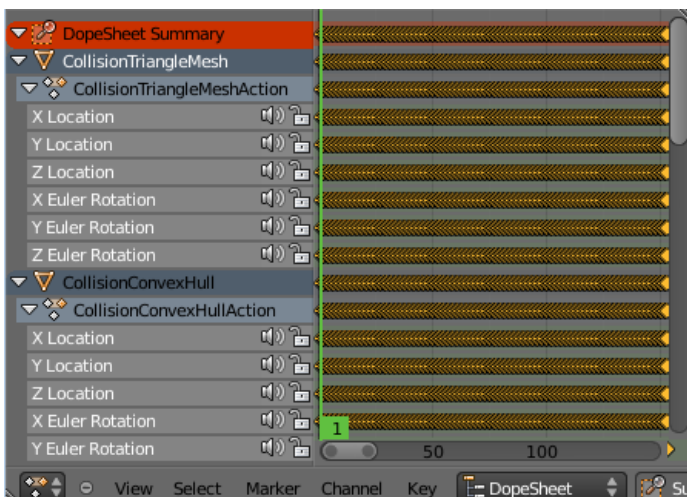


Menu to record Keyframes to the Dopesheet.

All you have to do to achieve this effect is go to the Info Editor (the bar at the top of the window) Game » Record Animation, and it will lock away your keyframes for use in Blender Render mode. You can go back to the 3D view and hit AltA to play it back, or CtrlF12 to render it out as an animation.

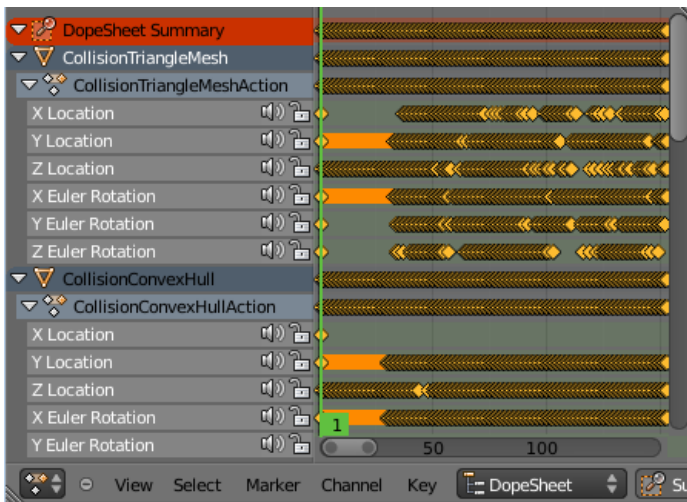
Note that, through use of Game Logic Bricks, you can interact with the Game Engine as it is playing. That means you can record a part-simulated part-user-controlled animation.

Keyframe Clean-up



The mess that "Record Animation" leaves behind.

You will find that Record Animation machine-guns keyframes all over the place. It will probably be a keyframe per channel per frame, wall-to-wall. Some of this data is redundant due to unchanging channels.



After hitting O.

Simply press O while in the DopeSheet and it will remove all keyframes that do not represent a value change compared to the one to its left. Though this will not suddenly make your data dead simple, it will at least give you some clues about where the action/inaction areas are in the timeline.

Don't forget that the animation does not have to play starting from Frame 1. The keyframes will insert beginning at your current Frame position, or else you can use the [NLA Editor](#) and turn these things into Action Strips.

Recording to .bullet File

You can snapshot the physics world at any time with the following code:

```
import bge
bge.constraints.exportBulletFile("test.bullet")
```

This will allow importing into other Bullet-based projects. See the [Bullet Wiki on Serialization](#) for more.

Mesh Deformations

As mentioned above, Rigid Body physics do not affect mesh deformations, nor do they account for them in the physics model. This leaves you with a few options:

Soft Bodies

You can try using a [Soft Body](#), but these are fairly hard to configure well.

Actions

To use an [Action Actuator](#) to do the deformation, you have to make a choice. If you use Shapekeys in the Action, you will be fine as far as the overall collisions (but see below for the note on `reinstancePhysicsMesh()`). The mesh itself is both a display and a physics mesh, so there is not much to configure.

To use an Armature as the deformer will require a bit of extra thought and effort. Basically the Armature will only deform a mesh if the Armature is the parent of that mesh. But at that point, your mesh will lose its physics responsiveness, and only hang in the air (it's copying the location/rotation of the Armature). To somewhat fix this you can then parent the Armature to a collision mesh (perhaps a simple box or otherwise very-low-poly mesh). This "Deformation Mesh" will be the physics representative, being type: Dynamic or Rigid Body, but it will be set to Invisible. Then "Display Mesh" will be the opposite set to type: No Collision, but visible. This still leaves us with the problem mentioned in the previous paragraph.

When you deform a display mesh, it does not update the corresponding physics mesh. You can view this evidently when you [Enable Physics Visualization](#) - the collision bounds will remain exactly as when they began. To fix this, you must call `own.reinstancePhysicsMesh()` in some form. Currently this only works on Triangle Mesh bounds, not Convex Hull. We have prepared a demonstration file in [Manual-BGE-Physics-DancingSticks.blend](#). Note that we had to increase the World » Physics » Physics Steps » Substeps to make the collisions work well. The more basic case is the case the Shapekeyed Action, which you can see in the back area of the scene. Since it is the only object involved, you can call `reinstancePhysicsMesh()` unadorned, and it will do the right thing.

The more complicated case is the Collision Mesh » Armature » Display Mesh cluster, which you can see in the front of the scene. What it does in the .blend is call `reinstancePhysicsMesh(viz)`, that is, passing in a reference to the visual mesh. If we tried to establish this relationship without the use of Python, we would find that Blender's dependency check system would reject it as a cyclic setup. This is an example of where Blender's checking is too coarsely-grained, as this circle is perfectly valid: the grandparent object (the Collision Mesh) controls the location/rotation, while the middle object (the Armature) receives the animated Action, where the child (the Display Mesh) receives the deformation, and passes that on up to the top, harmlessly. Something to note is that the Collision Mesh is merely a plane -- that is all it requires for this, since it will be getting the mesh data from `viz`.

Ragdolls

A third option is to create your items out of many sub-objects, connected together with Rigid Body Joints or similar. This can be quite a bit more work, but the results can be much more like a realistic response to collisions. For an Addon that can help you out in the process, check out the [Blender Ragdoll Implementation Kit](#).

Digging Deeper

Sometimes you will want to look at:

- The main Bullet Physics page - <http://bulletphysics.org/wordpress/>
- The Bullet Wiki - <http://www.bulletphysics.org/mediawiki-1.5.8/index.php?title=Documentation>
- The Bullet API Docs - <http://www.continuousphysics.com/Bullet/BulletFull/index.html>
- The Bullet Forums - <http://www.bulletphysics.org/Bullet/phpBB3/>

Then there is always:

Reading the Blender and Bullet Source Files

This might sound intimidating, even if you know C/C++, but it can be very informative. You can see how Blender sets up the objects to pass to Bullet, add `printf()`s in places, or otherwise experiment and `svn revert` to get back to normalcy.

Here is an example of the trail to get to the bottom of the handling of the options. We will observe the handling of the `use_shape_match` property, as an example.

- Start by getting [The Blender Source Tree](#)
- If you search it for `use_shape_match` (e.g., by `grep -r use_shape_match .`), this will lead you to [blender/source/blender/makesrna/intern/rna_object_force.c](#), which says:

```
prop = RNA_def_property(srna, "use_shape_match", PROP_BOOLEAN, PROP_NONE);
RNA_def_property_boolean_sdna(prop, NULL, "flag", OB_BSB_SHAPE_MATCHING);
RNA_def_property_ui_text(prop, "Shape Match", "Enable soft body shape matching goal");
```

- From this we see that the internal flag is set from the value of `OB_BSB_SHAPE_MATCHING`
- Searching for that leads us to:
 - Its simple initialization in [blender/blenkernel/intern/bullet.c](#)
 - Its assignment to `objprop.m_gamesoftFlag`, an object of type `KX_ObjectProperties`, in [gameengine/Converter/BL_BlenderDataConversion.cpp](#) -- so far, only passing the value, no actual decision-making.
- Searching for that leads us to [gameengine/Physics/Bullet/CcdPhysicsController.cpp](#) where we can find the following:

```
if (m_cci.m_gamesoftFlag & CCD_BSB_SHAPE_MATCHING) //OB_SB_GOAL)
{
    psb->setPose(false,true); //
} else
{
    psb->setPose(true,false);
}
```

- Here is the first bit of logic. It inverts the arguments to `setPose` depending on the value. Now then, since `psb` is of type `btSoftBody`, we have officially launched into Bullet territory. You have a couple options:
 - If you go to the [Bullet API Navigator](#) and expand the Class List menu, you can CtrlF for the `btSoftBody` class, and follow the link to the [btSoftBody Class Reference](#) Page. There you will see very sparse written documentation, but it will, at least, link you to a syntax-highlighted [line](#) where the method is implemented.
 - Get the Bullet Source with: `svn checkout http://bullet.googlecode.com/svn/trunk/ bullet-read-only` and probably run something like `ctags -r .` from that tree every now and then to build the `tags` file. Now you can dig further. Something like `vim -t setPose` will lead you to the implementation in [src/BulletSoftBody/btSoftBody.cpp](#) (which is the same code as can be found through the Bullet API Navigator in the previous step).
- Through either approach, we find that the mysterious `bools` above are for `btSoftBody::setPose(bool bvolume,bool bframe)`, which are immediately assigned to `m_pose.m_bvolume` and `m_pose.m_bframe`, respectively.
 - Subsequently searching for `m_bvolume` doesn't show much use in this file, other than the assignment and initialization. We could follow the trail deeper to the [btSoftBody::Pose Struct Reference](#) docs, but for now let's try:
 - Searching for `m_pose.m_bframe`. At this point, in this file, we have finally found the end of the simple passing of the flags, and we will see major chunks of code that are branched depending on this setting.

- Whether we can learn anything apparent at this point will depend on our ability to understand the code and concepts within the Bullet implementation. Perhaps we followed a multi-step process to find inscrutability, but at least we can see the very lines executed within the BGE.
 - Now we have some symbols to search for in [Google](#) or in the [Bullet Forums](#).
 - If we wanted to instrument this code with debugging `printf()`s, we could compile it and link it into our Blender build.

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Static Physics Object Type

Static objects in the [Blender Game Engine](#) do not automatically react to physics, including gravity and collisions. Even if hit by the force of a speeding 18-wheeler truck, it will remain unresponsive in terms of location, rotation, or deformation.

It will, however, give collision reactions. Objects will bounce off of Static Objects, and rotational inertia will transfer to objects capable of rotating (that is, Rigid Body Objects will spin in response, though Dynamic Objects will not).

Note that none of this prevents you from transforming the Static Objects with [Logic Bricks](#) or Python code. The visual objects will correctly move and their physics representation will update in the engine as well.

Another important note is that the default [Collision Bounds](#) is a Triangle Mesh, meaning it is higher in computational requirements but also in detail. This in turn means the "Radius" option has no effect by default.

In the example game demo, [Frijoles](#), the Static type is represented by the "Arena" object that holds all the moving bits.

For more documentation, see the [Top BGE Physics page](#).

Options



bpy Access

Note that most of these properties are accessible through the non-BGE scripting API via `bpy.data.objects["ObjectName"].game`, which is of type `bpy.types.GameObjectSetting`. This is useful so you can, for example, set a range of objects to have graduated values via a for-loop.

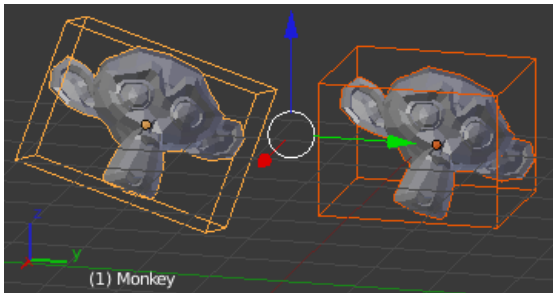
- Actor - Enables detection by Near and Radar Sensors.
 - Default: On.
 - Python property: `obj.game.use_actor`
- Ghost - Disables collisions completely, similar to No Collision.
 - Default: Off.
 - Python property: `obj.game.use_ghost`
- Invisible - Does not display, the same as setting the object to unrendered (such as unchecking the "Camera" icon in the [Outliner](#)).
 - Demo: The "ClothCatcher" object in top of [Frijoles.blend](#)
 - Default: Off.
 - Python property: `obj.use_render`
- Radius - If you have the "Collision Bounds: Sphere" set explicitly (or implicitly through having the Collision Bounds subpanel unchecked), this will multiply with the Object's (unapplied) Scale. Note that none of the other bounds types are affected. Also note that in the 3D View the display will show this for all types, even though it is only actually used with Sphere.
 - Range: 0.01-10.
 - Default: 1.
 - Python property: `obj.game.radius`
 - Demo: The table below describes the results visible in [Manual-BGE-Physics_BoundsRadiusAndScale.blend](#).

Basic	Radius=1.5	Unapplied Scale	Applied Scale	Collision Bounds
Rolls, radius of 1 BU	Rolls, radius of 1.5 BU (after "popping" upward)	Rolls, radius of 1.5 BU	Rolls, radius of 1 BU (!)	Default (which is Sphere)
Slides, extent of 1 BU	Slides, extent of 1 BU	Slides, extent of 1.5 BU	Slides, extent of 1.5 BU	Box
""	""	""	""	Convex Hull
Slides, extent of 1 BU (but with more friction than above)	Slides, extent of 1 BU (but with more friction than above)	Acts insane	Slides, extent of 1.5 BU	Triangle Mesh

- Anisotropic Friction - Isotropic friction is identical at all angles. Anisotropic is directionally-dependant. Here you can vary the coefficients for the three axes individually, or disable friction entirely.
 - Range: 0.1-1.
 - Default: 1.
 - Python properties: `obj.game.use_anisotropic_friction` (boolean) and `obj.game.friction_coefficients` (a 3-element array).

Collision Bounds

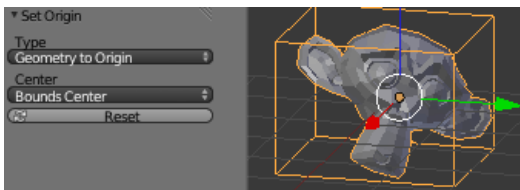
Note: The Static type differs from the others in that it defaults to a Triangle Mesh bounds, instead of a simple sphere.



Demonstration of a Local Bounding Box (left) and a Global Bounding Box (right). The monkeys are identical, except the right one has had its rotation applied with CtrlAR

The first thing you must understand is the idea of the 3d Bounding Box. If you run through all the vertices of a mesh and record the lowest and highest x values, you have found the x min/max---the complete boundary for all x values within the mesh. Do this again for y and z, then make a rectangular prism out of these values, and you have a Bounding Box. This box could be oriented relative globally to the world or locally to the object's rotation.

The x extent, then, is half of the distance between the x min/max.



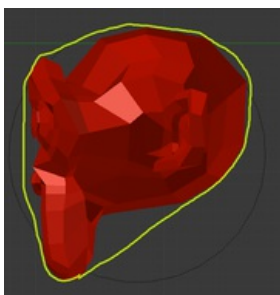
Setting the origin to Bounds Center instead of Median Center.

Throughout all of this you must be cognizant of the Object Origin. For the Game engine, the default CtrlAlt⇧ ShiftC,3 (Set Origin » Origin to Geometry) is unlikely to get the desired placement of the Collision Bounds that you want. Instead, you should generally set the origin by looking at the T-toolshelf after you do the Set Origin, and changing the Center from Median Center to Bounds Center. Blender will remember this change for future CtrlAlt⇧ ShiftC executions.

All Collision Bounds are centered on this origin. All boxes are oriented locally, so object rotation matters.

A final introductory comment: When you set the Collision Bounds on an object, Blender will attempt to display a visualization of the bounds in the form of a dotted outline. Currently, there is a bug: The 3D View does not display this bounds preview where it actually will be during the game. To see it, go to Game » Show Physics Visualization and look for the white (or green, if sleeping) geometry.

Now we can explain the various options for the Collision Bounds settings:



A convex hull sketch



Another way to create Collision Bounds -- By

hand.

- (Default)
 - For Dynamic and Static objects, it is a Triangle Mesh (see below).
 - For everything else, it is a Sphere (see below).
- Capsule - A cylinder with hemispherical caps, like a pill.
 - Radius of the hemispheres is the greater of the x or y extent.
 - Height is the z bounds
- Box - The x,y,z bounding box, as defined above.
- Sphere -
 - Radius is defined by the object's scale (visible in the N properties panel) times the physics radius (can be found in Physics » Attributes » Radius).
 - Note: This is the only bounds that respects the Radius option.
- Cylinder
 - Radius is the greater of the x or y extent.
 - Height is the z bounds.
- Cone
 - Base radius is the greater of the x or y extent.
 - Height is the z bounds.
- Convex Hull - Forms a shrink-wrapped, simplified geometry around the object.
 - For the math, see [Wikipedia's entry on Convex Hull](#) or [Wolfram's entry on Convex Hull](#).
 - For a demo, see the image to the right, where we have sketched a hull around Suzanne's profile:
- Triangle mesh - Most expensive, but most precise. Collision will happen with all of triangulated polygons, instead of using a virtual mesh to approximate that collision.
- By Hand - This is not an option in the Physics tab's Collision Bounds settings, but a different approach, entirely. You create a second mesh, which is invisible, to be the physics representation. This becomes the parent for your display object. Then, your display object is set to ghost so it doesn't fight with the parent object. This method allows you to strike a balance between the accuracy of Triangle Mesh with the efficiency of some of the others. See the demo of this in the dune buggy to the right.

Options

There are only two options in the Collision Bounds subpanel.

- Margin - "Add extra margin around object for collision detection, small amount required for stability." If you find your objects are getting stuck in places they shouldn't, try increasing this to, say, 0.06.
 - Sometimes 0.06 is the default (such as on the Default Cube), but sometimes it is not. You have to keep an eye on the setting, or else learn the symptoms so you can respond when it gives you trouble.
 - You can see somewhat of a demo in [Manual-BGE-Physics_Margins.blend](#). Here, the 0.0 settings are not clearly wrong, but they are different from the 0.06 settings. The 1.0 are simply wrong for the Box and Convex Hull objects. As you will notice, as of 2.62, the Margin has an odd effect on "Sphere" Collision Bounds types. It is almost imperceptibly different - so you will have to see the System Console to view the z-axis measurement. When you look at it, you will find that the purple row of Sphere bounds objects behave nearly identically in spite of the varying Margins.
 - The range is 0.0-1.0
 - If you're lazy/paranoid/unsure/diligent/bored, you can always run this on the Python Console to bump all 0.0 margins to 0.06:

```
for obj in bpy.data.objects: obj.game.collision_margin = obj.game.collision_margin or 0.06
```
- Compound - "Add children to form compound collision object." Basically, if you have a child object and do not have this enabled, the child's collisions will not have an effect on that object "family" (though it will still push other objects around). If you do have it checked, the parent's physics will respond to the child's collision (thus updating the whole family). For a demonstration, look at the far right of the top row of [Manual-BGE-Physics-CollisionBounds.blend](#). In it, the Empty.001 has "Compound" unchecked, and so it falls down, while Empty.001 has it checked, and behaves properly. Python property: `obj.game.use_collision_compound`

Example Demo

To see working examples of most of the types of Collision Bounds configurations, see [Manual-BGE-Physics-CollisionBounds.blend](#). The objects in red have some kind of flawed setting, and the green ones are the improved versions. It already has the Show Physics Visualization setting checked, so when you hit P you will see the bounds behavior in white wireframes.

Here you will see:

- First Row:
 - A rotated Cube, with and without "Collision Bounds" checked (demonstrates that the default bounds does not rotate with the object rotation).
 - The difference between setting object origins to the default "Median" center versus the "Bounds" center.
 - Suzanne falling onto a custom shelf, perfectly made for her jaw shape. Only Triangle Mesh results in good behavior for this one.
 - Options:
 - (Excessively) increased Margin.
 - Compound when parenting is involved.
- Second Row:

- All 7 incorrect types of bounds (for this case).
- 3 correct types (Convex Hull, Triangle Mesh, and custom).

Origin, Rotation, Scale

You must understand Applying Rotation/Scale with CtrlA and setting object Origins with CtrlAlt⇧ ShiftC. As mentioned in the [Collision Bounds Section](#), the default behavior for Set Origin is to put it at the Median Center, but for the BGE you will usually want to use Bounds Center.

Some examples, as demonstrated in: [Manual-BGE-Physics-TransformApply.blend](#)

- An object's bounds are defined by the min/max of all the vertices for each of the axes. The center of gravity is defined by its Origin (the orange dot in the 3d View).
- Rotating does not affect the default collision bounds -- Collision Bounds option must be enabled if you want to explicitly set the type of Collision Bounds so that you can choose a type where rotation has an effect.
- Scaling *does* affect the object's bounds effective radius value, but if you CtrlAS (Apply Scale), the bounds pop back out to a larger size. You must set the Collision Bounds (or the Radius) explicitly if you want a more correct physics representation.

Create Obstacle

TODO.

- It has to do with pathfinding and obstacle avoidance.
- from the recent Recast (generating navmeshes) and Detour (navmesh/pathfinding) additions:
<http://code.google.com/p/recastnavigation/>
- World > Obstacle simulation

All Types

[Comparison Table](#) - [No Collision](#) | [Static](#) | [Dynamic](#) | [Rigid Body](#) | [Soft Body](#)

No Collision Physics Object Type

"No Collision" objects in the [Game Engine](#) are completely unaffected by [Physics](#), and do cause physics reactions. They are useful as pure display objects, such as the child of a [Custom Collision Hull](#).

In the example game demo, [Frijoles](#), the No Collision type is represented by the "HUD" objects that display the health status.

For more documentation, see the [Top BGE Physics page](#).

Options

The only option available on No Collision types is: [Doc:2.6/Manual/Game Engine/Physics/InvisibleOption](#)

All Types

[Comparison Table](#) - [No Collision](#) | [Static](#) | [Dynamic](#) | [Rigid Body](#) | [Soft Body](#)

Dynamic Physics Object Type

Dynamic objects in the [Game Engine](#) give/receive collisions, but when they do so they themselves do not rotate in response. So, a Dynamic ball will hit a ramp and slide down, while a Rigid Body ball would begin rotating.

If you do not need the rotational response the Dynamic type can save the extra computation.

Note that these objects can still be rotated with [Logic Bricks](#) or Python code. Their physics meshes will update when you do these rotations - so collisions will be based on the new orientations.

In the example game demo, [Frijoles](#), the Dynamic type is represented by the titular jumping beans. Though we want these characters to recoil back when they hit a Boulder or each other, having them torque in response to these collisions would result in their being impossible to control.

For more documentation, see the [Top BGE Physics page](#).

Options



bpy Access

Note that most of these properties are accessible through the non-BGE scripting API via `bpy.data.objects["ObjectName"].game`, which is of type `bpy.types.GameObjectSetting`. This is useful so you can, for example, set a range of objects to have graduated values via a for-loop.

- Actor - Enables detection by Near and Radar Sensors.
 - Default: On.
 - Python property: `obj.game.use_actor`
- Ghost - Disables collisions completely, similar to No Collision.
 - Default: Off.
 - Python property: `obj.game.use_ghost`
- Invisible - Does not display, the same as setting the object to unrendered (such as unchecking the "Camera" icon in the [Outliner](#)).
 - Demo: The "ClothCatcher" object in top of [Frijoles.blend](#)
 - Default: Off.
 - Python property: `obj.use_render` [Doc:2.6/Manual/Game Engine/Physics/RightColumnOfOptions](#)
- Mass - Affects the reaction due to collision between objects -- more massive objects have more inertia. Will also affect material force fields. Will also change behaviors if you are using the suspension and steering portions of Bullet physics.
 - Demo: The three different Boulder sizes in [Frijoles.blend](#)
 - Range: 0.01-10,000.
 - Default: 1.
 - Python property: `obj.game.mass`

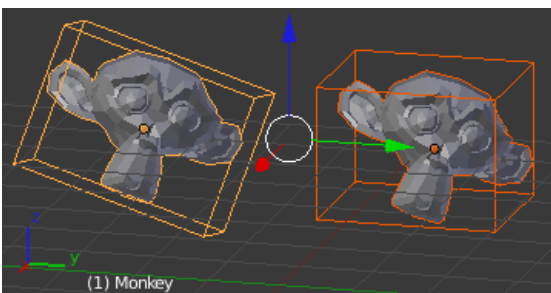
{{Category:Game_engine}}

- Radius - If you have the "Collision Bounds: Sphere" set explicitly (or implicitly through having the Collision Bounds subpanel unchecked), this will multiply with the Object's (unapplied) Scale. Note that none of the other bounds types are affected. Also note that in the 3D View the display will show this for all types, even though it is only actually used with Sphere.
 - Range: 0.01-10.
 - Default: 1.
 - Python property: `obj.game.radius`
 - Demo: The table below describes the results visible in [Manual-BGE-Physics_BoundsRadiusAndScale.blend](#).

Basic	Radius=1.5	Unapplied Scale	Applied Scale	Collision Bounds
Rolls, radius of 1 BU	Rolls, radius of 1.5 BU (after "popping" upward)	Rolls, radius of 1.5 BU	Rolls, radius of 1 BU (!)	Default (which is Sphere)
Slides, extent of 1 BU	Slides, extent of 1 BU	Slides, extent of 1.5 BU	Slides, extent of 1.5 BU	Box
""	""	""	""	Convex Hull
Slides, extent of 1 BU (but with more friction than above)	Slides, extent of 1 BU (but with more friction than above)	Acts insane	Slides, extent of 1.5 BU	Triangle Mesh

- Form Factor - For affecting the [Inertia Tensor](#). The higher the value, the greater the rotational inertia, and thus the more resistant to torque. You might think this is strange, considering Dynamic types do not have torque in response to collisions -- but you can still see this value's effects when you manually apply Torque.
 - Demo: [Manual-BGE-Physics-DynamicFormFactor.blend](#). The cube on the left has a Form Factor of 0.001, while the one on the right has a Form Factor of 1.0.
 - Range: 0-1.
 - Default: 0.4.
 - Python property: `obj.game.form_factor`
- Anisotropic Friction - Isotropic friction is identical at all angles. Anisotropic is directionally-dependant. Here you can vary the coefficients for the three axes individually, or disable friction entirely.
 - Range: 0.1-1.
 - Default: 1.
 - Python properties: `obj.game.use_anisotropic_friction` (boolean) and `obj.game.friction_coefficients` (a 3-element array).
- Velocity - Limit the speed of an object. "0" is no limit.
 - Range: 0-1000.
 - Suboption: Minimum - The object is allowed to be at complete rest, but as soon as it accelerates it will immediately jump to the minimum speed.
 - Default: 0.
 - Python property: `obj.game.velocity_min`
 - Suboption: Maximum - Top speed of the object.
 - Default: 0. (Unlimited.)
 - Python property: `obj.game.velocity_max`
- Damping - Increase the "sluggishness" of the object.
 - Range: 0-1.
 - Suboption: Translation - Resist movement. At "1" the object is completely immobile.
 - Range: 0-1.
 - Default: 0.0254.
 - Python property: `obj.game.damping`
 - Suboption: Rotation - Resist rotation, but not the kind of rotation that comes from a collision. For example, if a Motion Controller applies Torque to an object, this damping will be a factor.
 - Range: 0-1.
 - Default: 0.159.
 - Python property: `obj.game.rotation_damping`
- Lock Translation - Seize the object in the world along one or more axes. Note that this is global [coordinates](#), not local or otherwise.
 - Defaults: All off.
 - X - Python property: `obj.game.lock_location_x`
 - Y - Python property: `obj.game.lock_location_y`
 - Z - Python property: `obj.game.lock_location_z`
- Lock Rotation - Same, but for rotation (also with respect to the global coordinates).
 - Defaults: All off.
 - X - Python property: `obj.game.lock_rotation_x`
 - Y - Python property: `obj.game.lock_rotation_y`
 - Z - Python property: `obj.game.lock_rotation_z`

Collision Bounds

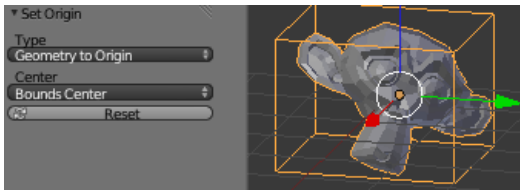


Demonstration of a Local Bounding Box (left) and a Global Bounding Box (right). The monkeys are identical, except the right one has had its rotation applied with CtrlAR

The first thing you must understand is the idea of the 3d Bounding Box. If you run through all the vertices of a mesh and record the lowest and highest x values, you have found the x min/max---the complete boundary for all x values within the mesh. Do this again for y and z, then make a rectangular prism out of these values, and you have a Bounding Box. This box could be oriented relative globally to

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The x extent, then, is half of the distance between the x min/max.



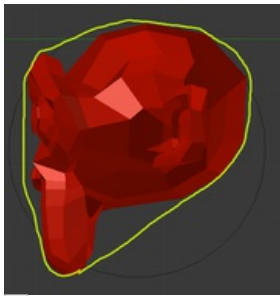
Setting the origin to Bounds Center instead of Median Center.

Throughout all of this you must be cognizant of the Object Origin. For the Game engine, the default `CtrlAlt+ShiftC,3` (Set Origin » Origin to Geometry) is unlikely to get the desired placement of the Collision Bounds that you want. Instead, you should generally set the origin by looking at the T-toolshelf after you do the Set Origin, and changing the Center from Median Center to Bounds Center. Blender will remember this change for future `CtrlAlt+ShiftC` executions.

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A final introductory comment: When you set the Collision Bounds on an object, Blender will attempt to display a visualization of the bounds in the form of a dotted outline. Currently, there is a bug: The 3D View does not display this bounds preview where it actually will be during the game. To see it, go to Game » Show Physics Visualization and look for the white (or green, if sleeping) geometry.

Now we can explain the various options for the Collision Bounds settings:



A convex hull sketch



Another way to create Collision Bounds -- By hand.

- (Default)
 - For Dynamic and Static objects, it is a Triangle Mesh (see below).
 - For everything else, it is a Sphere (see below).
- Capsule - A cylinder with hemispherical caps, like a pill.
 - Radius of the hemispheres is the greater of the x or y extent.
 - Height is the z bounds
- Box - The x,y,z bounding box, as defined above.
- Sphere -
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 - Note: This is the only bounds that respects the Radius option.
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You must understand Applying Rotation/Scale with CtrlA and setting object Origins with CtrlAlt+ ShiftC. As mentioned in the [Collision Bounds Section](#), the default behavior for Set Origin is to put it at the Median Center, but for the BGE you will usually want to use Bounds Center.

Some examples, as demonstrated in: [Manual-BGE-Physics-TransformApply.blend](#)

- An object's bounds are defined by the min/max of all the vertices for each of the axes. The center of gravity is defined by its Origin (the orange dot in the 3d View).
- Rotating does not affect the default collision bounds -- Collision Bounds option must be enabled if you want to explicitly set the type of Collision Bounds so that you can choose a type where rotation has an affect.
- Scaling *does* affect the object's bounds effective radius value, but if you CtrlAS (Apply Scale), the bounds pop back out to a larger size. You must set the Collision Bounds (or the Radius) explicitly if you want a more correct physics representation.

Create Obstacle

TODO.

- It has to do with pathfinding and obstacle avoidance.
- from the recent Recast (generating navmeshes) and Detour (navmesh/pathfinding) additions:
<http://code.google.com/p/recastnavigation/>
- World > Obstacle simulation

All Types

[Comparison Table](#) - [No Collision](#) | [Static](#) | [Dynamic](#) | [Rigid Body](#) | [Soft Body](#)

Rigid Body Physics Object Type

Probably the most common type of object in the [Game Engine](#). It will give/receive collisions and react with a change in its velocity and its rotation. A Rigid Body ball would begin rotating and roll down (where a [Dynamic](#) ball would only hit and slide down the ramp).

The idea behind Rigid Body dynamics is that the mesh does not deform. If you need deformation you will need to either go to [Soft Body](#) or else fake it with animated Actions.

In the example game demo, [Frijoles](#), the Rigid Body type is represented by the Boulders that spawn from the top of the level. Notice how they tumble and roll in response to the collisions with the Arena.

For more documentation, see the [Top BGE Physics page](#).

Options



bpy Access

Note that most of these properties are accessible through the non-BGE scripting API via `bpy.data.objects["ObjectName"].game`, which is of type `bpy.types.GameObjectSetting`. This is useful so you can, for example, set a range of objects to have graduated values via a for-loop.

- Actor - Enables detection by Near and Radar Sensors.
 - Default: On.
 - Python property: `obj.game.use_actor`
- Ghost - Disables collisions completely, similar to No Collision.
 - Default: Off.
 - Python property: `obj.game.use_ghost`
- Invisible - Does not display, the same as setting the object to unrendered (such as unchecking the "Camera" icon in the [Outliner](#)).
 - Demo: The "ClothCatcher" object in top of [Frijoles.blend](#)
 - Default: Off.
 - Python property: `obj.use_render`
- Mass - Affects the reaction due to collision between objects -- more massive objects have more inertia. Will also affect material force fields. Will also change behaviors if you are using the suspension and steering portions of Bullet physics.
 - Demo: The three different Boulder sizes in [Frijoles.blend](#)
 - Range: 0.01-10,000.
 - Default: 1.
 - Python property: `obj.game.mass`

{{Category:Game_engine}}

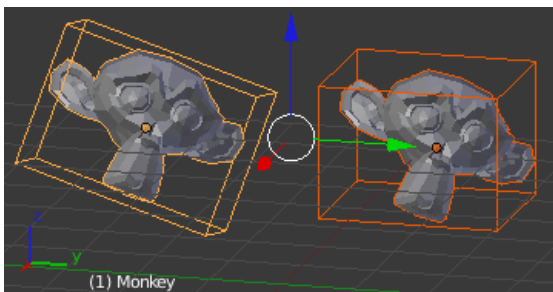
- Radius - If you have the "Collision Bounds: Sphere" set explicitly (or implicitly through having the Collision Bounds subpanel unchecked), this will multiply with the Object's (unapplied) Scale. Note that none of the other bounds types are affected. Also note that in the 3D View the display will show this for all types, even though it is only actually used with Sphere.
 - Range: 0.01-10.
 - Default: 1.
 - Python property: `obj.game.radius`
 - Demo: The table below describes the results visible in [Manual-BGE-Physics_BoundsRadiusAndScale.blend](#).

Basic	Radius=1.5	Unapplied Scale	Applied Scale	Collision Bounds
Rolls, radius of 1 BU	Rolls, radius of 1.5 BU (after "popping" upward)	Rolls, radius of 1.5 BU	Rolls, radius of 1 BU (!)	Default (which is Sphere)
Slides, extent of 1 BU	Slides, extent of 1 BU	Slides, extent of 1.5 BU	Slides, extent of 1.5 BU	Box
""	""	""	""	Convex Hull
Slides, extent of 1 BU (but with more friction than above)	Slides, extent of 1 BU (but with more friction than above)	Acts insane	Slides, extent of 1.5 BU	Triangle Mesh

- Form Factor - For affecting the [Inertia Tensor](#). The higher the value, the greater the rotational inertia, and thus the more resistant to torque. You might think this is strange, considering Dynamic types do not have torque in response to collisions -- but you can still see this value's effects when you manually apply Torque.

- Demo: [Manual-BGE-Physics-DynamicFormFactor.blend](#). The cube on the left has a Form Factor of 0.001, while the one on the right has a Form Factor of 1.0.
- Range: 0-1.
- Default: 0.4.
- Python property: `obj.game.form_factor`
- Anisotropic Friction - Isotropic friction is identical at all angles. Anisotropic is directionally-dependant. Here you can vary the coefficients for the three axes individually, or disable friction entirely.
 - Range: 0.1-1.
 - Default: 1.
 - Python properties: `obj.game.use_anisotropic_friction` (boolean) and `obj.game.friction_coefficients` (a 3-element array).
- Velocity - Limit the speed of an object. "0" is no limit.
 - Range: 0-1000.
 - Suboption: Minimum - The object is allowed to be at complete rest, but as soon as it accelerates it will immediately jump to the minimum speed.
 - Default: 0.
 - Python property: `obj.game.velocity_min`
 - Suboption: Maximum - Top speed of the object.
 - Default: 0. (Unlimited.)
 - Python property: `obj.game.velocity_max`
- Damping - Increase the "sluggishness" of the object.
 - Range: 0-1.
 - Suboption: Translation - Resist movement. At "1" the object is completely immobile.
 - Range: 0-1.
 - Default: 0.0254.
 - Python property: `obj.game.damping`
 - Suboption: Rotation - Resist rotation, but not the kind of rotation that comes from a collision. For example, if a Motion Controller applies Torque to an object, this damping will be a factor.
 - Range: 0-1.
 - Default: 0.159.
 - Python property: `obj.game.rotation_damping`
- Lock Translation - Seize the object in the world along one or more axes. Note that this is global [coordinates](#), not local or otherwise.
 - Defaults: All off.
 - X - Python property: `obj.game.lock_location_x`
 - Y - Python property: `obj.game.lock_location_y`
 - Z - Python property: `obj.game.lock_location_z`
- Lock Rotation - Same, but for rotation (also with respect to the global coordinates).
 - Defaults: All off.
 - X - Python property: `obj.game.lock_rotation_x`
 - Y - Python property: `obj.game.lock_rotation_y`
 - Z - Python property: `obj.game.lock_rotation_z`

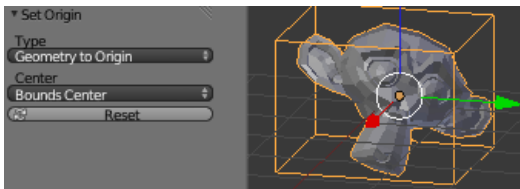
Collision Bounds



Demonstration of a Local Bounding Box (left) and a Global Bounding Box (right). The monkeys are identical, except the right one has had its rotation applied with CtrlAR

The first thing you must understand is the idea of the 3d Bounding Box. If you run through all the vertices of a mesh and record the lowest and highest x values, you have found the x min/max---the complete boundary for all x values within the mesh. Do this again for y and z, then make a rectangular prism out of these values, and you have a Bounding Box. This box could be oriented relative globally to the world or locally to the object's rotation.

The x extent, then, is half of the distance between the x min/max.



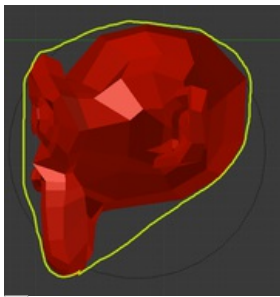
Setting the origin to Bounds Center instead of Median Center.

Throughout all of this you must be cognizant of the Object Origin. For the Game engine, the default **CtrlAlt⇧ ShiftC,3** (Set Origin » Origin to Geometry) is unlikely to get the desired placement of the Collision Bounds that you want. Instead, you should generally set the origin by looking at the T-toolshelf after you do the Set Origin, and changing the Center from Median Center to Bounds Center. Blender will remember this change for future **CtrlAlt⇧ ShiftC** executions.

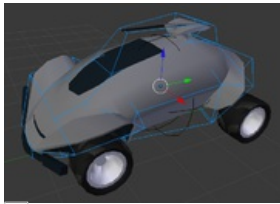
All Collision Bounds are centered on this origin. All boxes are oriented locally, so object rotation matters.

A final introductory comment: When you set the Collision Bounds on an object, Blender will attempt to display a visualization of the bounds in the form of a dotted outline. Currently, there is a bug: The 3D View does not display this bounds preview where it actually will be during the game. To see it, go to **Game » Show Physics Visualization** and look for the white (or green, if sleeping) geometry.

Now we can explain the various options for the Collision Bounds settings:



A convex hull sketch



Another way to create Collision Bounds -- By hand.

- (Default)
 - For Dynamic and Static objects, it is a Triangle Mesh (see below).
 - For everything else, it is a Sphere (see below).
- Capsule - A cylinder with hemispherical caps, like a pill.
 - Radius of the hemispheres is the greater of the x or y extent.
 - Height is the z bounds
- Box - The x,y,z bounding box, as defined above.
- Sphere -
 - Radius is defined by the object's scale (visible in the N properties panel) times the physics radius (can be found in **Physics » Attributes » Radius**).
 - Note: This is the only bounds that respects the Radius option.
- Cylinder
 - Radius is the greater of the x or y extent.
 - Height is the z bounds.
- Cone
 - Base radius is the greater of the x or y extent.
 - Height is the z bounds.
- Convex Hull - Forms a shrink-wrapped, simplified geometry around the object.
 - For the math, see [Wikipedia's entry on Convex Hull](#) or [Wolfram's entry on Convex Hull](#).
 - For a demo, see the image to the right, where we have sketched a hull around Suzanne's profile:
- Triangle mesh - Most expensive, but most precise. Collision will happen with all of triangulated polygons, instead of using a virtual mesh to approximate that collision.
- By Hand - This is not an option in the Physics tab's Collision Bounds settings, but a different approach, entirely. You create a second mesh, which is invisible, to be the physics representation. This becomes the parent for your display object. Then, your display object is set to ghost so it doesn't fight with the parent object. This method allows you to strike a balance between the

accuracy of Triangle Mesh with the efficiency of some of the others. See the demo of this in the dune buggy to the right.

Options

There are only two options in the Collision Bounds subpanel.

- Margin - "Add extra margin around object for collision detection, small amount required for stability." If you find your objects are getting stuck in places they shouldn't, try increasing this to, say, 0.06.
 - Sometimes 0.06 is the default (such as on the Default Cube), but sometimes it is not. You have to keep an eye on the setting, or else learn the symptoms so you can respond when it gives you trouble.
 - You can see somewhat of a demo in [Manual-BGE-Physics_Margins.blend](#). Here, the 0.0 settings are not clearly wrong, but they are different from the 0.06 settings. The 1.0 are simply wrong for the Box and Convex Hull objects. As you will notice, as of 2.62, the Margin has an odd effect on "Sphere" Collision Bounds types. It is almost imperceptibly different - so you will have to see the System Console to view the z-axis measurement. When you look at it, you will find that the purple row of Sphere bounds objects behave nearly identically in spite of the varying Margins.
 - The range is 0.0-1.0
 - If you're lazy/paranoid/unsure/diligent/bored, you can always run this on the Python Console to bump all 0.0 margins to 0.06:

```
for obj in bpy.data.objects: obj.game.collision_margin = obj.game.collision_margin or 0.06
```
- Compound - "Add children to form compound collision object." Basically, if you have a child object and do not have this enabled, the child's collisions will not have an effect on that object "family" (though it will still push other objects around). If you do have it checked, the parent's physics will respond to the child's collision (thus updating the whole family). For a demonstration, look at the far right of the top row of [Manual-BGE-Physics-CollisionBounds.blend](#). In it, the Empty.001 has "Compound" unchecked, and so it falls down, while Empty.001 has it checked, and behaves properly. Python property: `obj.game.use_collision_compound`

Example Demo

To see working examples of most of the types of Collision Bounds configurations, see [Manual-BGE-Physics-CollisionBounds.blend](#). The objects in red have some kind of flawed setting, and the green ones are the improved versions. It already has the Show Physics Visualization setting checked, so when you hit P you will see the bounds behavior in white wireframes.

Here you will see:

- First Row:
 - A rotated Cube, with and without "Collision Bounds" checked (demonstrates that the default bounds does not rotate with the object rotation).
 - The difference between setting object origins to the default "Median" center versus the "Bounds" center.
 - Suzanne falling onto a custom shelf, perfectly made for her jaw shape. Only Triangle Mesh results in good behavior for this one.
 - Options:
 - (Excessively) increased Margin.
 - Compound when parenting is involved.
- Second Row:
 - All 7 incorrect types of bounds (for this case).
 - 3 correct types (Convex Hull, Triangle Mesh, and custom).

Origin, Rotation, Scale

You must understand Applying Rotation/Scale with CtrlA and setting object Origins with CtrlAlt+ ShiftC. As mentioned in the [Collision Bounds Section](#), the default behavior for Set Origin is to put it at the Median Center, but for the BGE you will usually want to use Bounds Center.

Some examples, as demonstrated in: [Manual-BGE-Physics-TransformApply.blend](#)

- An object's bounds are defined by the min/max of all the vertices for each of the axes. The center of gravity is defined by its Origin (the orange dot in the 3d View).
- Rotating does not affect the default collision bounds -- Collision Bounds option must be enabled if you want to explicitly set the type of Collision Bounds so that you can choose a type where rotation has an effect.
- Scaling *does* affect the object's bounds effective radius value, but if you CtrlAS (Apply Scale), the bounds pop back out to a larger size. You must set the Collision Bounds (or the Radius) explicitly if you want a more correct physics representation.

Create Obstacle

TODO.

- It has to do with pathfinding and obstacle avoidance.
- from the recent Recast (generating navmeshes) and Detour (navmesh/pathfinding) additions:
<http://code.google.com/p/recastnavigation/>

- World > Obstacle simulation

All Types

[Comparison Table](#) - [No Collision](#) | [Static](#) | [Dynamic](#) | [Rigid Body](#) | [Soft Body](#)

Soft Body Physics Object Type

The most advanced type of object in the [Game Engine](#). Also, it is the most finicky. If you are used to the fun experimentation that comes from playing around with the non-BGE Soft Body sims (such as Cloth), you will probably find a frustrating lack of options and exciting results. Do not despair, we are here to help you get some reasonable settings.

Your setup will involve making sure you have sufficient geometry in the Soft Body's mesh to support the deformation, as well as tweaking the options.

In the example game demo, [Frijoles](#), the Soft Body type is represented by the decorative checkered flag at the top of the level.

For more documentation, see the [Top BGE Physics page](#).

Options

- Actor - Enables detection by Near and Radar Sensors.
 - Default: On.
 - Python property: `obj.game.use_actor`
- Ghost - Disables collisions completely, similar to No Collision.
 - Default: Off.
 - Python property: `obj.game.use_ghost`
- Invisible - Does not display, the same as setting the object to unrendered (such as unchecking the "Camera" icon in the [Outliner](#)).
 - Demo: The "ClothCatcher" object in top of [Frijoles.blend](#)
 - Default: Off.
 - Python property: `obj.use_render`
- Mass - Affects the reaction due to collision between objects -- more massive objects have more inertia. Will also affect material force fields. Will also change behaviors if you are using the suspension and steering portions of Bullet physics.
 - Demo: The three different Boulder sizes in [Frijoles.blend](#)
 - Range: 0.01-10,000.
 - Default: 1.
 - Python property: `obj.game.mass`

{{Category:Game_engine}}

- Shape Match - Upon starting the Game Engine this will record the starting shape of the mesh as the "lowest energy" state. This means that the edges will have tension whenever they are flexed to some other form. This is set to on by default, and in this configuration turns the object into more of a thin sheet of metal rather than a cloth.
 - Demo: [BGE-Physics-Objects-SoftBodies_ShapeMatchAndLinearStiffness.blend](#)
 - Default: On.
 - Code effect: When on, it will call `btSoftBody::setPose(false,true)`
 - Python property: `obj.game.soft_body.use_shape_match`
 - Suboption: Threshold - [Linearly scales the pose match](#)
 - A threshold of 1.0 makes it behave like Shape Match on with a Linear Stiffness of 1.0.
 - A threshold of 0.0 makes it behave like Shape Match off with a Linear Stiffness of 0.0.
 - Range: 0-1.
 - Default: 0.5.
 - Code effect: Sets `btSoftBody::Config::kMT`.
 - Python property: `obj.game.soft_body.shape_threshold`
- Welding - **[Note: Seems to not be hooked up. Blender will tell Bullet to weld any time you enable Soft Body. Look at [BL_BlenderDataConversion.cpp](#) where `objprop.m_soft_welding` is hard-coded to 0.0]**
- Position Iteration - Increase the accuracy at a linearly-increasing expense of time. The effect is visible especially with Soft Bodies that fall on sharp corners, though this can slow down even very simple scenes.
 - Demo: A situation where only the max setting of 10 works correctly: [BGE-Physics-Objects-SoftBodies_PositionIterations.blend](#).
 - Range: 0-10.
 - Default: 2.
 - Code effect: Represents the number of times [this loop](#) is run.
 - Python property: `obj.game.soft_body.location_iterations`
- Linear Stiffness - Linear stiffness of the soft body links. This is most evident when you have Shape Match off, but it is also evident with it on.
 - Demo: [BGE-Physics-Objects-SoftBodies_ShapeMatchAndLinearStiffness.blend](#)
 - Range: 0-1.
 - Default: 0.5.
 - Python property: `obj.game.soft_body.linear_stiffness`
- Friction - Dynamic friction coefficient. **TODO: Learn/demo/explain.**
 - Code effect: Sets `btSoftBody::Config::kMT`, which, for Soft Bodies, defines the minimum friction versus the Material Friction (which in turn defaults to 0.5).

- Range: 0-1.
- Default: 0.2.
- Python property: `obj.game.soft_body.dynamic_friction`
- Margin - Small value makes the algorithm unstable. **TODO: Learn/demo/explain.**
 - Range: 0.01-1.
 - Default: 0.01.
 - Python property: `obj.game.soft_body.collision_margin`
- Bending Constraint - Enable Bending Constraints **TODO: Learn/demo/explain.**
 - Default: On.
 - Python property: `obj.game.soft_body.use_bending_constraints`
- Cluster Collision - Affects Collision sensors as well as physics.
 - Demo: [BGE-Physics-Objects-SoftBodies_ClusterRigidToSoftBody.blend](#) for a demonstration of the effect on the [Collision Sensor](#). There you will observe the "Rigid to Soft Body" off, then on with iterations of 1, 64, and 128. The Off and iterations: 1 cases do not register collisions, and the other two do (though they send their poor Cubes flying into space).
 - Demo of badness: [Manual-BGE-Physics-SoftBody_BadClusterCollisions.blend](#) - four different ways of making misconfigured Soft Body objects.
 - Suboption: Rigid to Soft Body - Enable cluster collisions between Rigid and Soft Bodies.
 - Default: Off.
 - Python property: `obj.game.soft_body.use_cluster_rigid_to_softbody`
 - Suboption: Soft to Soft Body - Enable cluster collisions among Soft Bodies.
 - Default: Off.
 - Python property: `obj.game.soft_body.use_cluster_soft_to_softbody`
 - Suboption: Iterations - Number of cluster iterations.
 - Range: 1-128.
 - Default: 64.
 - Python property: `obj.game.soft_body.cluster_iterations`

Hints

- A very important configurable in the case of Soft Body interactions is [World properties](#) » Physics » Physics Steps » Substeps. In the test .blend here: [Manual-BGE-Physics-SoftBody_PhysicsSteps.blend](#), you can see the behavior at various Substep levels:
 1. The default level. The Grid object goes straight through the cube, hardly slowing down at all.
 2. The Grid slows upon hitting the Cube's top face, and stops fully on the bottom face.
 3. The Grid stops at the top face, but two opposite Cube corners are visible.
 4. ...no perceptible difference.
 5. Finally a working sim. This is good, because it is the maximum step level.
- Surprisingly, the more vertices you have in your hit object, the less likely the Soft Body is to react with it. If you try letting it hit a Plane, it might stop, but a subdivided Grid might fail.

Goal Weights

TODO:

http://www.blender.org/documentation/blender_python_api_2_62_release/bpy.ops.curve.html#bpy.ops.curve.spline_weight_set

Force Fields

A common practice within the non-BGE Cloth simulator is to employ [Force Fields](#) to animate the cloth.

These do not work in the BGE, so you will have to figure out a way to use Python (or perhaps plain Logic Bricks) to apply forces to the Soft Body objects.

All Types

[Comparison Table](#) - [No Collision](#) | [Static](#) | [Dynamic](#) | [Rigid Body](#) | [Soft Body](#)

Occlude Object Type.

If an Occlude type object is between the camera and another object, that other object will not be rasterized (calculated for rendering). It is "[culled](#)" because it is "[occluded](#)".

The overall process (also known as "o-culling") disregards, by default, anything outside of the [View Frustum](#), meaning you don't have to worry about anything outside the view's rectangular border. Inside this border, you might want to do additional culling.

In this demo .blend, [BGE-Physics-Objects-Occluder.blend](#), you will see:

- A messed-up, subdivided Cube named "Cube".
- Another one behind a "Physics Type: Occlude" plane, named "Cube.BG".
- Another one outside the view Frustum, named "Cube.OffCamera".

Now observe what happens to the profiling stats for each of the following (in order):

1. Hit P as the scene is. It hums along at a fairly slow rate. On my system the Rasterizer step takes 130ms. The framerate will finally jump up once the "Cube" object has completely moved out of the view frustum. ??? - It's as if the Occluder doesn't do anything while the Cube is behind it.
2. Delete the "Cube.OffCamera" object above, and notice that there is no improvement in speed. This is the view frustum culling working for you - it does not matter if that object exists or not.
3. Hit Z to view wireframe. Notice that in the 3D Viewport you can see "Cube.BG", but once you hit P, it is not there.
4. Make the "Occluder" object take up the whole camera's view with SX5. You will see a huge leap in framerate, since almost nothing is being Rasterized. On my system the Rasterizer step drops to 5ms.
5. Try a run with World properties » Physics » Occlusion Culling disabled. It will be slow again.
6. Reenable World properties » Physics » Occlusion Culling and run it one more time to prove to yourself that your speed is back.
7. Change the Occluder to "Physics Type: Static". Notice that it is back to the original slowness.
8. Change it back to "Physics Type: Occlude".
9. Now make the "Occluder" invisible. The framerate is back down to its original, slow rate. ??? - I thought this was supposed to work when invisible.

TODO

Incorporate some of the [2.49 Release Notes Details](#).

Details

As far as Physics is concerned, this type is equivalent to Rigid Object "No collision". The reason why the Occluder mode is mutually exclusive with other physics mode is to emphasize the fact that occluders should be specifically designed for that purpose and not every mesh should be an occluder. However, you can enable the Occlusion capability on physics objects using Python and Logic bricks - see (Link- TODO)

When an occluder object enters the view frustum, the BGE builds a ZDepth buffer from the faces of that object. Whether the faces are one-side or two-side is important: only the front faces and two-side faces are used to build the ZDepth buffer. If multiple occluders are in the view frustum, the BGE combines them and keeps the most foreground faces.

The resolution of the ZDepth buffer is controllable in the World settings with the "Occlu Res" button:

By default the resolution is 128 pixels for the largest dimension of the viewport while the resolution of the other dimension is set proportionally. Although 128 is a very low resolution, it is sufficient for the purpose of culling. The resolution can be increased to maximum 1024 but at great CPU expense.

The BGE traverses the DBVT (Dynamic Bounding Volume Tree) and for each node checks if it is entirely hidden by the occluders and if so, culls the node (and all the objects it contains).

To further optimize the feature, the BGE builds and uses the ZDepth buffer only when at least one occluder is in the view frustum. Until then, there is no performance decrease compared to regular view frustum culling.

Recommendations

Occlusion culling is most useful when the occluders are large objects (buildings, mountains, ...) that hide many complex objects in an unpredictable way. However, don't be too concerned about performance: even if you use it inappropriately, the performance decrease will be limited due to the structure of the algorithm.

There are situations where occlusion culling will not bring any benefit:

- If the occluders are small and don't hide many objects.

- In that case, occlusion culling is just dragging your CPU down).
- If the occluders are large but hides simple objects.
 - In that case you're better off sending the objects to the GPU).
- If the occluders are large and hides many complex objects but in a very predictable way.
 - Example: a house full of complex objects. Although occlusion culling will perform well in this case, you will get better performance by implementing a specific logic that hides/unhides the objects; for instance making the objects visible only when the camera enters the house).
- Occluders can be visible graphic objects but beware that too many faces will make the ZDepth buffer creation slow.
 - For example, a terrain is not a good candidate for occlusion: too many faces and too many overlap. Occluder can be invisible objects placed inside more complex objects (ex: "in the walls" of a building with complex architecture). Occluders can have "holes" through which you will see objects.

Bullet physics Python API

Bullet Physics provides collision detection and rigid body dynamics for the Blender Game Engine. It takes some settings from Blender that previously were designed for the former collision detection system (called Sumo).

However, new features don't have an user interface yet, so Python can be used to fill the gap for now.

Features:

- Vehicle simulation.
- Rigid body constraints: hinge and point to point (ball socket).
- Access to internal physics settings, like deactivation time, debugging features.

Easiest is to look at the Bullet physics demos, how to use them. More information can be found [here](#).

Python script example:

```
import PhysicsConstraints
print dir(PhysicsConstraints)
```

The VideoTexture module

The `VideoTexture` module allows you to manipulate textures during the game. Several sources for texture are possible: video files, image files, video capture, memory buffer, camera render or a mix of that. The video and image files can be loaded from the internet using an URL instead of a file name. In addition, you can apply filters on the images before sending them to the GPU, allowing video effect: blue screen, color band, gray, normal map. `VideoTexture` uses FFmpeg to load images and videos. All the formats and codecs that FFmpeg supports are supported by `VideoTexture`, including but not limited to:

- AVI
- Ogg
- Xvid
- Theora
- dv1394 camera
- video4linux capture card (this includes many webcams)
- videoForWindows capture card (this includes many webcams)
- JPG

How it works

The principle is simple: first you identify an existing texture by object and name, then you create a new texture with dynamic content and swap the two textures in the GPU. The GE is not aware of the substitution and continues to display the object as always, except that you are now in control of the texture. At the end, the new texture is deleted and the old texture restored.

The present page is a guide to the `VideoTexture` module with simple examples.

Game preparation

Before you can use the thing `VideoTexture` module, you must have objects with textures applied appropriately.

Imagine you want to have a television showing live broadcast programs in the game. You will create a television object and UV-apply a different texture at the place of the screen, for example “`tv.png`”. What this texture looks like is not important; probably you want to make it dark grey to simulate power-off state. When the television must be turned on, you create a dynamic texture from a video capture card and use it instead of `tv.png`: the TV screen will come to life.

You have two ways to define textures that `VideoTexture` can grab:

1. Simple UV texture.
2. Blender material with image texture channel.

Because `VideoTexture` works at texture level, it is compatible with all GE fancy texturing features: GLSL, multi-texture, custom shaders, etc.

First example

Let’s assume that we have a game object with one or more faces assigned to a material/image on which we want to display a video.

The first step is to create a `Texture` object. We will do it in a script that runs once. It can be at the start of the game, the video is only played when you refresh the texture; we’ll come to that later. The script is normally attached to the object on which we want to display the video so that we can easily retrieve the object reference:

```
import VideoTexture

contr = GameLogic.getCurrentController()
obj = contr.owner

if not hasattr(GameLogic, 'video'):
```

The check on “`video`” attribute is just a trick to make sure we create the texture only once.

Find material

```
matID = VideoTexture.materialID(obj, 'IMvideo.png')
```

`VideoTexture.materialID()` is a handy function to retrieve the object material that is using `video.png` as texture. This method will work with Blender material and UV texture. In case of UV texture, it grabs the internal material corresponding to the faces that are assigned to this texture. In case of Blender material, it grabs the material that has an image texture channel matching the name as first channel.

The “IM” prefix indicates that we’re searching for a texture name but we can also search for a material by giving the “MA” prefix. For example, if we want to find the material called `VideoMat` on this object, the code becomes:

```
matID = VideoTexture.materialID(obj, 'MAVideoMat')
```

Create texture

`VideoTexture.Texture` is the class that creates the `Texture` object that loads the dynamic texture on the GPU. The constructor takes one mandatory and three optional arguments:

`gameObj`

The game object.

`materialID`

Material index as returned by `VideoTexture.materialID()`, 0 = first material by default.

`textureID`

Texture index in case of multi-texture channel, 0 = first channel by default.
In case of UV texture, this parameter should always be 0.

`textureObj`

Reference to another `Texture` object of which we want to reuse the texture.
If we use this argument, we should not create any source on this texture and there is no need to refresh it either: the other `Texture` object will provide the texture for both materials/textures.

```
GameLogic.video = VideoTexture.Texture(obj, matID)
```

Make texture persistent

Note that we have assigned the object to a `GameLogic` “video” attribute that we create for the occasion. The reason is that the `Texture` object must be persistent across the game scripts. A local variable would be deleted at the end of the script and the GPU texture deleted at the same time. `GameLogic` module object is a handy place to store persistent objects.

Create a source

Now we have a `Texture` object but it can’t do anything because it does not have any source. We must create a source object from one of the possible sources available in `VideoTexture`:

`VideoFFmpeg`

Moving pictures.
Video file, video capture, video streaming.

`ImageFFmpeg`

Still pictures.
Image file, image on web.

`ImageBuff`

Image from application memory.
For computer generated images, drawing applications.

`ImageViewport`

Part or whole of the viewport (=rendering of the active camera displayed on screen).

`ImageRender`

Render of a non active camera.

`ImageMix`

A mix of 2 or more of the above sources.

In this example we use a simple video file as source. The `VideoFFmpeg` constructor takes a file name as argument. To avoid any confusion with the location of the file, we will use `GameLogic.expandPath()` to build an absolute file name, assuming the video file is in the same directory as the blend file:

```
movie = GameLogic.expandPath('//trailer_400p.ogg')
GameLogic.video.source = VideoTexture.VideoFFmpeg(movie)
```

We create the video source object and assign it to the `Texture` object `source` attribute to set the source and make it persistent: as the `Texture` object is persistent, the source object will also be persistent.

Note that we can change the `Texture` source at any time. Suppose we want to switch between two movies during the game. We can do the following:

```
GameLogic.mySources[0] = VideoTexture.VideoFFmpeg('movie1.avi')
GameLogic.mySources[1] = VideoTexture.VideoFFmpeg('movie2.avi')
```

And then assign (and reassign) the source during the game:

```
GameLogic.video.source = GameLogic.mySources[movieSel]
```

Setup the source

The `VideoFFmpeg` source has several attributes to control the movie playback:

```
range
    [start,stop] (floats).
    Set the start and stop time of the video playback, expressed in seconds from beginning. By default the entire video.

repeat
    (integer).
    Number of video replay, -1 for infinite.

framerate
    (float).
    Relative frame rate, <1.0 for slow, >1.0 for fast.

scale
    (bool).
    Set to True to activate fast nearest neighbour scaling algorithm.
    Texture width and height must be a power of 2. If the video picture size is not a power of 2, rescaling is required. By default
    VideoTexture uses the precise but slow gluScaleImage() function. Best is to rescale the video offline so that no scaling is
    necessary at runtime!

flip
    (bool).
    Set to True if the image must be vertically flipped.
    FFmpeg always delivers the image upside down, so this attribute is set to True by default.

filter
    Set additional filter on the video before sending to GPU.
    Assign to one of VideoTexture filter object. By default the image is send unchanged to the GPU. If an alpha channel is present in
    the video, it is automatically loaded and sent to the GPU as well.
```

We will simply set the `scale` attribute to True because the `gluScaleImage()` is really too slow for real time video. In case the video dimensions are already a power of 2, it has no effect.

```
GameLogic.video.source.scale = True
```

Play the video

We are now ready to play the video:

```
GameLogic.video.source.play()
```

Video playback is not a background process: it happens only when we refresh the texture. So we must have another script that runs on every frame and calls the `refresh()` method of the `Texture` object:

```
if hasattr(GameLogic, 'video'):
    GameLogic.video.refresh(True)
```

If the video source is stopped, `refresh()` has no effect. The argument of `refresh()` is a flag that indicates if the texture should be recalculated on next refresh. For video playback, you definitively want to set it to True.

Checking video status

Video source classes (such as `VideoFFmpeg`) have an attribute `status`. If video is playing, its value is 2, if it's stopped, it's 3. So in our example:

```
if GameLogic.video.source.status == 3:
    #video has stopped
```

Advanced work flow

True argument in `Texture.refresh()` method simply invalidates the image buffer after sending it to the GPU so that on next frame, a

new image will be loaded from the source. It has the side effect of making the image unavailable to Python. You can also do it manually by calling the `refresh()` method of the source directly.

Here are some possible advanced work flow:

- Use the image buffer in python (doesn't effect the Texture):

```
GameLogic.video.refresh(False)
image = GameLogic.video.source.image
# image is a binary string buffer of row major RGBA pixels
# ... use image
# invalidates it for next frame
GameLogic.video.source.refresh()
```

- Load image from source for python processing without download to GPU:

```
# note that we don't even call refresh on the Texture
# we could also just create a source object without a Texture object

image = GameLogic.video.source.image
# ... use image
GameLogic.video.source.refresh()
```

- If you have more than 1 material on the mesh and you want to modify a texture of one particular material, get its ID

```
matID=VideoTexture.materialID(gameobj, "MAMat.001")
```

GLSL material can have more than 1 texture channel, identify the texture by the texture slot where it is defined, here 2

```
tex=VideoTexture.Texture(gameobj, matID, 2)
```

Download the demo

You can find the demo [here](#).

Advanced demos

Here is a [demo](#) that demonstrates the use of two videos alternatively on the same texture. Note that it requires an additional video file which is the elephant dream teaser. You can replace with another other file that you want to run the demo.

Here is a [demo](#) that demonstrates the use of the `ImageMix` source. `ImageMix` is a source that needs sources, which can be any other Texture source, like `VideoFFmpeg`, `ImageFFmpeg` or `ImageRender`. You set them with `setSource()` and their relative weight with `setWeight()`. Pay attention that the weight is a short number between 0 and 255, and that the sum of all weights should be 255. `ImageMix` makes a mix of all the sources according to their weights. The sources must all have the same image size (after reduction to the nearest power of 2 dimension). If they don't, you get a Python error on the console.

Standalone Player

The standalone player allows a Blender game to be run without having to load the Blender system. This allows games to be distributed to other users, without their requiring a detailed knowledge of Blender (and also without the possibility of unauthorised modification). Note that the Game Engine Save as Runtime is an addon facility which must be pre-loaded before use.

The following procedure will give a standalone version of a working game.

- **File - User Preferences - Addons: - Game Engine - Save as Game Engine Runtime - Install Addon**(button).

(You can also **Save as Default** button, in which case the add-on will always be present whenever Blender is re-loaded).

- **File - Export - Save as Game Engine Runtime - (give appropriate directory/filename)- Save as Game Engine Runtime** (button).

The game can then be executed by running the appropriate .exe file. Note that all appropriate libraries are automatically loaded by the add-on.

If you are interested in licensing your game, read [Licensing](#) for a discussion of the issues involved.



Exporting...

If the game is to be exported to other computers, make a new empty directory for the game runtime and all its ancilliary libraries etc. Then make sure the **whole directory** is transferred to the target computer

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Licensing of Blender Games

The licensing of games created for distribution using the Blender Game Engine and the Standalone Player is complicated by Blender's status as open-source software. This page aims to describe the problems, and present some possible solutions.

Blender is distributed as open-source software distributed and owned by the Blender Foundation under the GNU General Public License (GPL). In brief, while the Blender system itself is available to everyone, you own anything that you make using Blender (scripts, texture, rendered artwork etc.). See <http://www.blender.org/education-help/faq/gpl-for-artists/> for further details.

Standalone Player License

Unfortunately, this does not extend to games or other artwork distributed to run under the Blender Standalone Player. To distribute your game you need to create an executable (run time). What it does is take your Blender .blend file and put it "inside" the Standalone Player - a stripped-down version of Blender containing only the functions corresponding to the Blender Game Engine. The resulting executable file falls into the category of "derivatives" of the original program (i.e. a hybrid of your file with the Standalone Player itself), and therefore must be licensed as GPL.

Distributing Games

There are four possible solutions to the problem of how to distribute your game with suitable license protection:

- 1) Do not protect your Blender Game by license. Are you really sure that you need to license it? Remember the old adage "Imitation is the sincerest form of flattery".
- 2) Pretend that there is no problem. It is very, very unlikely that the Blender Foundation will ever prosecute anyone for distributing a game that is based on the BGE.
- 3) Make use of an external system for running Blender games: e.g. BPPlayer or Gamekit (but these are not fully tested).
- 4) Use the Game Actuator, which enables a basic .blend game file to start. By making a basic file which contains an "Always" sensor to run, and allowing this to activate a "Game" actuator to load and run the full content of your game, this gets round the problem. Your main file is now "outside" the Standalone Player, so that it need not be open to GPL and is therefore "legally protected". Although your game is not fully protected with this system, it affords a similar level of protection to that used in most other distributed games. The fact that others can access your .blend file does not mean that it can be used for purposes not covered by the license you want.

(Acknowledgements: This page is based on information contained in the blog file of Dalai Felinto).